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SURVEILLANCE REPORT

Point prevalence survey of healthcare-associated infections and antimicrobial use in European long-term care facilities

2016–2017

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This report was commissioned by the European Centre for Disease Prevention and Control (ECDC) and coordinated by Tommi Kärki, Pete Kinross and Carl Suetens.

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Abbreviations

AMR	Antimicrobial resistance
AST	Antimicrobial susceptibility testing
ATC	Anatomical Therapeutic Chemical classification
cCI	Cumulative confidence interval
CI	Confidence interval
EEA	European Economic Area
ESAC-Net	European Surveillance of Antimicrobial Consumption Network
ESAC-NH	Subproject on nursing homes of the ESAC-Net project
EU	European Union
EUCAST	European Committee on Antimicrobial Susceptibility Testing
FAQ	Frequently asked question
FP	False positive
FN	False negative
GI	Gastrointestinal infection
GP	General practitioner
HAI	Healthcare-associated infection
HAI-Net	Healthcare-associated infections surveillance network
HALT	ECDC surveillance of healthcare-associated infections and antimicrobial use in European long-term care facilities
HALT (2010)	The first point prevalence survey of healthcare-associated infections and antimicrobial use in European long-term care facilities (2010)
HALT-2 (2013)	The second point prevalence survey of healthcare-associated infections and antimicrobial use in European long-term care facilities (2013)
HALT-3 (2016–2017)	The third point prevalence survey of healthcare-associated infections and antimicrobial use in European long-term care facilities (2016–2017)
IPC	Infection prevention and control
IQR	Interquartile range
LTC	Long-term care
LTCF	Long-term care facility
MDRO	Multidrug-resistant organism
MRSA	Meticillin-resistant *Staphylococcus aureus*
NH	Nursing home
NPV	Negative predictive value
OCP	Operational contact point
PI	Performance indicator
PPS	Point prevalence survey
PPV	Positive predictive value
R	Resistant
RH	Residential home
RTI	Respiratory tract infection
S	Susceptible
SHEA	Society for Healthcare Epidemiology of America
SSI	Surgical site infection
US CDC	United States Centers for Disease Control and Prevention
UTI	Urinary tract infection

Executive summary

In 2016–2017, the European Centre for Disease Prevention and Control (ECDC) organised the third point prevalence survey (PPS) of healthcare-associated infections (HAIs) and antimicrobial use in European long-term care facilities (LTCFs) or HALT-3. The design of the survey was based on the experiences and recommendations of the two previous PPSs in LTCFs organised by ECDC, i.e. HALT (2010) and HALT-2 (2013) [1, 2]. Specifically, HALT-3 used a standardised PPS methodology which aimed:

- to estimate and monitor the burden (prevalence) of HAIs and antimicrobial use in LTCFs at national and European levels;
- to measure the structure and process indicators of infection prevention and control (IPC) and antimicrobial stewardship in LTCFs;
- to identify priorities for national and local intervention measures in LTCFs, and to evaluate their implementation in Member States of the European Union (EU) and the European Economic Area (EEA).

ECDC invited EU/EEA countries and EU candidate countries to participate in one or more out of four surveillance periods: April–June 2016, September–November 2016, April–June 2017 and/or September–November 2017.

The ECDC Coordinating Competent Body (CCB) in each EU/EEA country nominated one or more persons to be Operational Contact Points (OCPs) for Epidemiology – HAIs in LTCFs (HAI-HALT). These OCPs were responsible for the organisation of the PPS at the national level, including the recruitment of LTCFs to participate in the PPS on a voluntary basis. The OCPs also classified the participating LTCFs into one of the ten distinct LTCF categories.

LTCFs were defined as facilities in which residents are medically stable, needing constant supervision (24 hours) with 'high-skilled nursing care' (i.e. more than 'basic' nursing care and assistance for daily living), and do not need constant 'specialised medical care' (i.e. administered by specialised physicians) or invasive medical procedures (e.g. ventilation). The following facilities were excluded: hospital long-term care wards, hostel care (hotel without any kind of nursing care), sheltered care houses, day centres, home-based centres, and protected living.

Data were collected by either a local data collector (e.g. designated physician, IPC doctor/nurse, head nurse, etc.) or an external data collector. Ideally, data collectors collected PPS data from each LTCF on one single day. In LTCFs with a large number of beds, data could be collected over two or more consecutive days, but all beds in one unit/ward had to be surveyed on the same day.

The HALT-3 protocol contained data collection forms for LTCFs and LTCF residents [3]. The LTCF forms were used to collect aggregate, LTCF-level denominator data, including demographic data, risk factors and care load indicators, as well as LTCF-level structure and process indicators of IPC and antimicrobial stewardship.

Residents were eligible, and could therefore be included in the survey, if they were living full-time (24 hours a day) in the LTCF and were present at 8:00 am on the day of the PPS and not discharged from the LTCF at the time of the survey. The resident-level forms collected data from residents receiving at least one antimicrobial agent and/or presenting at least one active HAI on the day of the PPS.

In contrast to the previous HALT surveys, in HALT-3, data were collected not only for the HAIs associated with the current LTCF, but also for HAIs acquired in other healthcare facilities, e.g. an acute care hospital or another LTCF. For such cases, the onset of symptoms had to occur >48 hours after the resident was (re-)admitted to the current LTCF, or <48 hours after the resident was (re-)admitted to the current LTCF from another healthcare facility (e.g. LTCF or hospital). Data on the detected microorganisms were recorded for residents who had one or more active HAIs on the day of the PPS. Antimicrobial susceptibility results were recorded for selected bacterium-antimicrobial combinations [3].

The resident-level forms were used to collect data on antimicrobial use for pre-specified groups of antimicrobial agents, up to Anatomical Therapeutic Chemical (ATC) level 4. These were antibacterials for systemic use (ATC level J01), antimycotics for systemic use (J02) and antifungals for systemic use (D01BA), antibiotics used as intestinal anti-infectives (A07AA), antiprotozoals (P01AB) and antimycobacterials (J04A) when used for treatment of mycobacteria including tuberculosis, or as reserve treatment for multidrug-resistant bacteria.

The HALT-3 PPS was performed by 24 countries/administrations and two EU candidate countries (North Macedonia and Serbia). Results from the EU candidate countries are presented separately in the tables and figures, and are not included in the aggregate results presented in this report.

France, the Netherlands, Norway and Sweden provided ECDC with a systematic random sample of data they had acquired through their own national PPS of HAI and antimicrobial use in LTCFs (the Netherlands, according their own protocol). France and Norway did not collect data on all HAIs because of their national protocols, so the missing data were imputed from the European averages from HALT-3. Cyprus and Czechia only collected data at the LTCF level. As a result, no detailed information on antimicrobial use or HAI data can be presented in this report for these countries. Czechia collected these data in January–March 2018, a later period that is not covered in this report.

Twenty-four EU/EEA countries submitted data for 3 052 LTCFs, of which 85.7% were general nursing homes, residential homes or mixed facilities. Eight countries had recruited notably large numbers of LTCFs. Therefore, to avoid their overrepresentation in the European dataset, a systematic random sample was drawn from the nursing homes, residential homes and mixed facilities. This resulted in the exclusion of some LTCFs from these countries: Belgium (n=165 excluded LTCFs), Germany (n=131), Finland (n=175), France (n=367), Hungary (n=262), Ireland (n=224), Italy (n=418), and Spain (n=53).

The final European HALT-3 dataset included 117 138 eligible residents from 2 232 LTCFs. General nursing homes, residential homes and mixed LTCFs represented 80.5% (n=1 797/2 232 LTCFs) of all participating LTCFs. Data from these relatively similar types of LTCFs are aggregated in the 'Results' section of this report, to promote comparability of national results. The results of the more specialised LTCFs (i.e. psychiatric LTCFs, LTCFs for mentally or physically disabled persons, rehabilitation centres, palliative care facilities, sanatoria, and 'other' LTCFs) are presented in a separate sub-chapter.

The majority of residents were female (overall median: 70.0%) and were older than 85 years (overall median: 50.0%). The median care load in LTCFs was high: the overall median prevalence of incontinence for urine and/or faeces was 69.3% of all the residents, 59.3% were disoriented (in time and/or space), and 48.8% suffered from an impaired mobility (i.e. wheelchair-user or bedridden).

The median size of the LTCFs (general nursing homes, residential homes and mixed LTCFs) was 43 beds. The overall median percentage of single-bed rooms among the total number of LTCF beds was 80.2%, while 46.0% of all beds were in single-bed rooms that had individual toilet and washing facilities.

The majority (71.0%) of LTCFs had at least one person with IPC training at their disposal, and 39.1% had an IPC committee. An external IPC team was reported as being available to provide support and advice to 84.6% of the LTCFs. Almost all (93.9%) LTCFs reported having a written hand hygiene protocol. Hand disinfection with alcohol solution was the most frequently reported hand hygiene method (70.3%). The median use of alcohol-based hand rub was 4.3 litres per 1 000 resident-days (mean: 32.7 liters/1 000 resident-days).

Of all the LTCFs with data, 28.5% did not have any of the ten specified antimicrobial stewardship elements in place. The two most commonly reported elements were, 'therapeutic formulary, comprising a list of antibiotics' (45.6%) and 'written guidelines for appropriate antimicrobial use (good practice) in the facility' (39.4%). A restrictive list of antimicrobials for prescription was only available in 24.0% of the LTCFs.

It was more common for LTCFs to have surveillance of antimicrobial-resistant microorganisms (41.5%), than surveillance of HAIs (35.5%) or antimicrobial consumption (31.0%).

The crude prevalence of residents with at least one HAI was 3.7%. The majority of the reported HAIs (n=3 858) were associated with the current LTCF (84.7%), while 7.5% and 1.4% were associated with a hospital or another LTCF, respectively. When only taking into account the HAIs that were associated with the current LTCF, the crude prevalence of residents with at least one HAI was 3.1%.

The most frequently reported HAIs associated with the current LTCF were respiratory tract infections (RTIs, 34.8%, of which 68.1% were lower RTIs other than pneumonia), urinary tract infections (UTIs, 32.5%), and skin infections (21.2%, of which 80.8% were cellulitis/soft tissue/wound infections). More than half of the UTIs (56.1%) were 'probable' UTIs, i.e. cases where the resident had enough signs/symptoms to suspect a UTI, but without microbiological confirmation (i.e. urine culture not done, or result negative, or not available at the time of the survey).

The overall percentage of HAIs with documented positive microbiological results at the time of the survey was 19.2%, which is relatively low. No microbiological examination had been performed for 46.7% HAIs, while for 29.1% HAIs the microbiological results were not available or unknown at the time of the survey. No microorganism was identifiable in cultures from 4.1% HAIs, and cultures were reported to have been negative, i.e. sterile for 0.9% HAIs. The proportion of HAIs with available microbiological data varied considerably between countries/administrations, and the results from HALT-3 on the isolated microorganisms should be interpreted with caution. The most frequent microorganisms reported in HAIs were *Escherichia coli* (30.7%), *Staphylococcus aureus* (12.3%), *Klebsiella pneumoniae* (9.8%), *Proteus mirabilis* (9.5%), and *Pseudomonas aeruginosa* (7.1%).

The overall crude prevalence of residents with at least one antimicrobial agent was 4.9%. Details on antimicrobial prescriptions were provided for 5 006 residents and 5 344 antimicrobial agents. Antimicrobials were mainly administered orally (88.1%) and prescribed within the LTCF itself (77.9%). An end or review date was documented in the residents' records for the majority (64.6%) of antimicrobial prescriptions.

Antimicrobial treatment (69.5%) was the main indication for antimicrobial prescribing. Prophylaxis accounted for 29.4% and the indication was unknown for 1.1% of the antimicrobials. Prophylactics were mainly used for UTIs (74.0%), while antimicrobial treatment was most frequently used for RTIs (37.2%), UTIs (34.4%) and skin or wound infections (15.8%).

Antibacterials for systemic use (ATC J01) represented 95.4% of all reported antimicrobials. The most frequently used classes within this group were penicillins (J01C; 30.2%), 'other antibacterials' (J01X; 18.6%), quinolones (J01M; 14.9%), sulfonamides and trimethoprim (J01E; 13.3%) and other beta-lactams (J01D; 12.6%).

Fifteen antimicrobial agents accounted for 75% of the total use in the participating LTCFs. The most frequently prescribed antimicrobials were amoxicillin and enzyme inhibitor (J01CR02; 13.7%), nitrofurantoin (J01XE01; 9.5%) and trimethoprim (J01EA01; 9.0%).

A multivariable linear regression model, which accounted for the variety of LTCF and resident characteristics, explained 20% and 21% of the variation of the prevalence of HAIs and antimicrobial use in LTCFs, respectively. A higher prevalence of HAIs and/or antimicrobial use was independently associated ($p<0.05$) with explored care load indicators and risk factors. The prevalence of both HAIs and antimicrobial use were associated with the number of LTCF beds in the facility, the percentage of residents older than 85 years, being wheelchair-bound or bedridden, having a wound other than a pressure sore, and the presence of urinary or vascular catheters. Additionally, HAI prevalence was associated with being disoriented in time and/or space; and the prevalence of antimicrobial use was associated with being male or having had surgery in the previous 30 days. A one percent increase in the proportion of residents with a vascular catheter, with wounds other than pressure sores, or with a urinary catheter was associated with an increase in HAI prevalence of 25%, 10% and 4%, respectively. For context, it is worth noting that these risk factors were relatively rare in LTCFs, i.e. the overall median proportion of vascular catheters, wounds other than pressure sores and urinary catheters was 0.0%, 3.5% and 5.6%, respectively.

The data collected during the third PPS (HALT-3) of HAIs and antimicrobial use in European LTCFs had several limitations. Many of these arose from the voluntary nature of participation in this survey at both country/administration and local level, as well as the relatively small size of the national teams available to work on HAIs and antimicrobial use in LTCFs. For example, although the national representativeness of the LTCF sample was classified as either 'good' or 'optimal' in 18 out of 26 countries/administrations, only three countries (France, Norway and Sweden) were able to draw a systematic random sample. All three obtained these from their national (HALT-like) PPS datasets.

It is important to note that the representativeness of a country/administration sample was not related to the quality of the survey in a country/administration, but rather to the extent to which the national results can be extrapolated to the entire country/administration. Feedback from participating countries/administrations indicates that HALT-3 supported national efforts to raise awareness of IPC in LTCFs and beyond; knowledge that can also disseminate to the professional networks of LTCF staff.

Secondly, while data validity was high for antimicrobial use, the PPS sensitivity for capturing HAIs was somewhat lower and is likely to have led to a slight underestimation of HAI prevalence. Moreover, the inclusion in the HALT-3 protocol of HAIs associated with other healthcare facilities and the option to report HAIs as 'imported', increased the complexity of the HALT-3 protocol leading potentially to an underestimated prevalence with the current LTCF with HAIs attributed to other healthcare facilities.

Notwithstanding these limitations, repeated PPSs are useful for monitoring trends in HAIs and antimicrobial use over time, and for estimating the burden of HAIs and antimicrobial use in LTCFs at national and European levels. The total annual number of HAIs in general nursing homes, residential homes and mixed facilities in the EU/EEA was estimated at 4.4 million (cumulative 95% confidence interval: 2.0–8.0 million).

The following areas of priority for LTCFs were identified for those working at the national and EU levels:

- Recommend to LTCFs that they participate in periodic PPSs of HAIs and antimicrobial use (Member State level);
- Enhance the level of IPC training among healthcare workers in LTCFs (Member State level);
- Reinforce access to external IPC support and expertise for LTCFs (Member State level);
- Encourage hand disinfection with alcohol-based hand rub as the main hand hygiene method, and increase awareness of the importance of hand hygiene in the prevention and control of HAIs and antimicrobial-resistant microorganisms (EU and Member State levels);
- Develop guidance for the detection and control of multidrug-resistant organisms in LTCFs and have guidelines available at national and LTCF levels (Member State level);
- Tailor basic antimicrobial stewardship programmes to improve antimicrobial prescribing in LTCFs (Member State level):
  - to rationalise the use of antimicrobials for prophylaxis;
  - to promote appropriate microbiological sampling in LTCFs;
  - to improve access to microbiological results for LTCF staff in charge of the residents' nursing care.
- Ensure appropriate use of antimicrobial agents for UTIs:
  - by promoting alternatives to the use of antimicrobials for the prevention of UTIs in LTCFs (EU and Member State levels);
  - by developing guidance for UTI diagnosis in the elderly residents, that distinguishes asymptomatic bacteriuria from symptomatic UTIs (EU and Member State levels);

  - by putting down guidelines for the treatment and prevention of UTIs at national and LTCF levels (EU and Member State levels);
  - by implementing the surveillance of UTIs and antimicrobial use for UTIs, at LTCF level (Member State level).
- Continue to study the association between the structure and process indicators of IPC and antimicrobial stewardship in European LTCFs, to support the production of evidence-based LTCF-specific guidelines (EU and Member State levels).

The HALT-3 PPS also made the following recommendations for PPSs in LTCFs, in the future:

- Continue to monitor HAIs and antimicrobial use using a standardised methodology across Europe;
- Continue to provide training to LTCF staff to harmonise the interpretation of case definitions;
- Explore additional measures to promote the participation of LTCFs in these PPSs and also their associated validation studies;
- Promote, in collaboration with national authorities, the importance of having a robust national/regional registry of LTCFs and LTCF beds, to enable the calculation of burden estimates of HAIs and antimicrobial use in LTCFs;
- Continue to ensure compatibility with previous PPSs in adaptions to the HALT protocol, while removing any indicator(s) deemed to have a too high cost/benefit ratio. For example, the utility of collecting data on HAIs associated with stays in other healthcare facilities and the option to report HAIs as 'imported infections' should be critically evaluated.
- ECDC should consider producing a data entry software for PPSs in LTCFs incorporating feedback from users during the HALT-3 PPS.

1 Background and objectives

In December 2008, the European Centre for Disease Prevention and Control (ECDC) initiated the surveillance of healthcare-associated infections (HAIs) and antimicrobial use in European long-term care facilities (LTCFs) under the project, Healthcare-associated Infections in Long-term Care Facilities (HALT). A protocol for point prevalence surveys (PPSs) in LTCFs was developed, which provided an integrated methodology for repeated assessment of the prevalence of HAIs, antimicrobial use, antimicrobial stewardship and infection prevention and control (IPC) resources in these facilities.

Two PPSs were then successfully organised. The first PPS (HALT, 2010) collected data from 722 LTCFs in 28 European countries/administrations, and the second PPS (HALT-2, 2013) was performed in 1 181 LTCFs across 19 European countries/administrations [1, 2]. The prevalences of residents with at least one antimicrobial agent were 4.3% and 4.4%, respectively. The prevalence of residents with at least one HAI was 2.4% in 2010 and 3.4% in 2013, but HAI case definitions and the methods for HAI data collection differed between the two PPSs.

In May 2015, ECDC launched a project to support a third PPS of HAIs and antimicrobial use in LTCFs (HALT-3) to be performed in 2016–2017. The contract was awarded to a consortium led by Sciensano (Brussels, Belgium) in collaboration with the Agenzia sanitaria e sociale regionale (Bologna, Italy).

The HALT-3 management team and advisory committee adapted the HALT-2 surveillance protocols and accompanying survey tools. At an ECDC train-the-trainers workshop on 1–2 December 2015, the nominated Operational Contact Points (OCPs) for Epidemiology – HAIs in LTCFs (HAI-HALT) from EU/EEA countries discussed the draft surveillance protocol, the validation methodology, forms for national-level data collection, training materials including the curriculum for a one-day course, and data entry software. Subsequently, ECDC published the protocol for the main HALT-3 PPS and a validation survey on its website [3, 4].

The aim of the main HALT-3 PPS protocol [3] was to provide a standardised tool to enable the specific objectives of HALT-3, which were as follows:

- To estimate and monitor the burden (prevalence) of HAIs and antimicrobial use in LTCFs at national and European levels;
- To measure the structure and process indicators of IPC and antimicrobial stewardship in LTCFs;
- To identify priorities for national and local intervention measures in LTCFs, and to evaluate their implementation in EU/EEA countries.

The protocol specified that participating countries perform the PPS during one or more of four surveillance periods: April–June 2016, September–November 2016, April–June 2017 and/or September–November 2017.

The main objectives of the validation survey [4] were: a) to acquire data to adjust European estimates of the prevalence of HAIs and antimicrobial use through a review of LTCF resident charts by a national team, on the same day as the main PPS in that LTCF; and b) to acquire qualitative feedback on the indicators collected, using the main protocol.

The HALT-3 management team offered an optional two-day onsite assessment visit to the national team in each participating EU/EEA country. The objectives of the visit were to support national teams in their completion of the protocol regarding national-level data, i.e. national performance indicators of IPC and antimicrobial stewardship, feedback on the impact of repeated PPSs in LTCFs at national and local levels, and the collection of national denominator data. Additionally, a member of the management team was available to accompany the national team during a validation survey, if it was concurrent [5].

2 Methodology

2.1 Participation

2.1.1 National/regional participation

All the EU/EEA countries were invited, through ECDC's healthcare-associated infections surveillance network (HAI-Net), to participate in HALT-3: the third PPS of HAIs and antimicrobial use in European LTCFs. EU candidate and potential candidate countries were also invited.

The ECDC Coordinating Competent Body in each EU/EEA country nominated one or more persons to be Operational Contact Points (OCPs) for Epidemiology – HAIs in LTCFs (HAI-HALT). The United Kingdom (UK) nominated an OCP to act as overall UK coordinator, and nominated one OCP for each UK devolved administration, as each devolved administration would collect data independently. Therefore, in this report, the results for each UK devolved administration are reported separately.

All countries/administrations sought to recruit LTCFs nation-wide, except for Greece (which only recruited LTCFs in Crete) and Spain (which only recruited LTCFs in the autonomous communities of Madrid and Catalonia, providing these together as 'national data').

2.1.2 LTCF participation

All types of LTCFs were eligible to participate in the PPS, according to the HALT-2 definition of an LTCF [3], i.e. a facility in which residents:

- need constant supervision (24 hours);
- need 'high-skilled nursing care' (i.e. more than 'basic' nursing care and assistance for daily living);
- are medically stable and do not need constant 'specialised medical care' (i.e. care administered by specialised physicians) or invasive medical procedures (e.g. ventilation).

The following facilities were excluded: hospital long-term care wards, hostel care (hotel without any kind of nursing care), sheltered care houses, day centres, home-based centres, and protected living.

The protocol specified that the OCPs classify the LTCFs, by applying the definitions provided in the protocol. This included ten types of LTCF: general nursing home (NH), residential home (RH), six types of specialised LTCFs: psychiatric LTCFs, LTCFs for mentally disabled persons, LTCFs for physically disabled persons, rehabilitation centres, palliative care facilities, sanatoria; mixed LTCFs (all or some of the above) and 'other' type of LTCF. The protocol provided five categories regarding the intended average length of stay of residents: temporary short (<3 months), temporary medium (3–12 months), temporary long (>12 months, not definitive), definitive stay (i.e. until the end of life), and 'other'. Additionally, each LTCF was classified according to its resident population: mentally disabled persons only, physically disabled persons only, psychiatric residents only, rehabilitation only, convalescent only, intensive care only, all or some of the above, and 'other' resident population.

As in HALT (2010) and HALT-2 (2013), data from the most similar and the most frequently recruited types of LTCF are aggregated in the main result section of this report into general nursing homes, residential homes and mixed facilities. This has been done to minimise differences that are likely to have arisen from variations in the national interpretations of the definitions of the different types of LTCF. The results of the more specialised LTCFs are presented in a separate chapter.

2.2 HALT-3 surveillance protocol

Following a train-the-trainers workshop in December 2015, ECDC distributed protocols in early 2016 for the HALT-3 PPS [3], the validation study [4], and national-level data collection [5] to the OCPs, via a password-protected website (ECDC's HAI-Net extranet), together with training materials, the HALT-3 data entry software, and an updatable list of frequently asked questions (FAQs).

Unlike the PPS of HAIs and antimicrobial use in European acute care hospitals, 2016–2017, the protocol only described one single method for data collection. It contained a form to collect aggregate LTCF-level denominator data from each participating LTCF, i.e. demographic data, risk factors, care load indicators and structure and process indicators of IPC and antimicrobial stewardship for the entire LTCF population. A separate form was used to collect data for each resident who had at least one active HAI and/or received at least one antimicrobial agent on the day of the PPS.

Further methodological details are available in the published protocol [3].

2.2.1 Representativeness of national samples of LTCFs

Countries/administrations were encouraged to draw a representative sample of LTCFs, through systematic random sampling of a national/regional register of LTCFs. As participation was voluntary, other methods of recruitment were permitted e.g. convenience samples.

The calculation of the recommended national sample size and the criteria to categorise the national representativeness of the LTCF sample for the PPS (Table 1) were presented for discussion at the train-the trainers workshop and in the draft protocols distributed to countries/administrations, prior to their publication in the main protocol [3].

At the country/administration level, the recommended sample size was calculated using data from HALT (2010) and HALT-2 (2013), such as the total reported number of LTCF beds in that country/administration and the number of beds in each participating LTCF. As the calculation incorporated an anticipated crude prevalence of 4.0%, with 1% precision for the 95% confidence interval, the sample size is most appropriate for a prevalence of that magnitude, such as HAIs or antimicrobial use [3].

Table 1. Criteria to categorise the national representativeness of the LTCF sample for the PPS

Optimal	Systematic random sample of at least 25 LTCFs, or at least 75% of the recommended number of LTCFs to be sampled; or Inclusion of at least 75% of all LTCFs, or occupied LTCF beds in the country/administration and recommended sample size achieved.
Good	Selection of at least 25 LTCFs, or at least 75% of the recommended number of LTCFs and/or residents to be sampled using another methodology (e.g. voluntary participation); or Recommended sample size not achieved, but inclusion of ≥75% of all LTCFs or occupied LTCF beds in the country/administration.
Poor	Between five and 25 LTCFs included in countries/administrations with more than 25 LTCFs and recommended sample size not achieved; or Less than five LTCFs included in countries/administrations with more than five LTCFs, but inclusion of 50–75% of all LTCFs or occupied LTCF beds in the country/administration.
Very poor	Inclusion of less than five LTCFs, less than 50% of all LTCFs, and less than 50% of all occupied LTCF beds.

Source: Protocol for point prevalence surveys of healthcare-associated infections and antimicrobial use in European long-term care facilities [3]

To avoid overrepresentation, ECDC selected a systematic random sample of LTCFs from the data sent by countries/administrations that had recruited more than the required number of LTCFs. Following this sampling, 820 LTCFs were excluded from the following countries: Belgium (n=79 excluded LTCFs), Germany (n=47), Finland (n=18), France (n=276), Hungary (n=151), Ireland (n=39), Italy (n=203) and Spain (n=7). France, Norway and Sweden submitted a systematic random sample of the LTCFs that had participated in their national surveys (see Section 2.3, 'National PPS protocols').

2.2.2 Survey date

Countries/administrations conducted the PPS in LTCFs during one or more of four surveillance periods: April–June 2016, September–November 2016, April–June 2017, and/or September–November 2017.

Preferably, data were collected from each LTCF on one single day. In LTCFs with a large number of beds, data collection could take place over two or more consecutive days, but all beds in one unit/ward had to be surveyed on the same day.

In 2017–2018, several non-participating countries/administrations indicated that the potential workload of the HALT-3 protocol was a barrier to participation. Therefore, in September 2018, ECDC offered non-participating countries/administrations the option to only collect LTCF-level data in the HALT-3 protocol any time before 31 March 2018.

2.2.3 Eligibility of residents

Residents were eligible, and could therefore be included in the survey, if they were living full-time (24 hours a day) in the LTCF and were present at 8:00 am on the day of the PPS and not discharged from the LTCF at the time of the survey. Residents who regularly received chronic ambulatory care in an acute care hospital (e.g. haemodialysis or chemotherapy) were eligible for inclusion, unless they were hospitalised on the day of the PPS, i.e. a hospital stay of at least one night.

National PPS coordination teams ensured that national guidelines were followed regarding the consent of residents to participate in the PPS.

2.2.4 Data collectors and tools

Depending on the available resources, data were collected either by a local data collector (e.g. designated physician, IPC doctor/nurse, head nurse, etc.), or an external data collector (e.g. IPC doctor/nurse) recruited by the OCP, or members of the national PPS coordination team.

Data were collected using two questionnaires, an LTCF questionnaire and a resident questionnaire.

The LTCF form was used to collect data from each participating LTCF on its denominators (demographic data, risk factors and care load indicators for the entire LTCF population), structural and functional characteristics (e.g. public/private ownership, presence of qualified nurses, medical coordination), and structure and process indicators of IPC and antimicrobial stewardship.

Resident-level forms were completed for each resident who received at least one antimicrobial agent and/or presented with at least one 'active HAI' on the day of the PPS. The protocol contained materials to support the completion of this form, such as a list of codes for microorganisms and their antimicrobial susceptibility profiles.

Data entry could be done using the 'HALT-3 software tool'. This stand-alone software consisted of two applications, one for national centres (NCs) and one for LTCFs. The 'NC application' allowed national teams to enter, review, edit and export data. The LTCF application was used to enter data from the LTCF-level and resident-level forms, thereafter, generating a summary report and exporting data that could be imported into the NC application.

2.2.5 Care load indicators and risk factors

The survey explored three care load indicators and five risk factors in the total resident population. The care load indicators were incontinence for urine and/or faeces, disorientation in time and/or space, and impaired mobility (i.e. wheelchair-user or bedridden). The risk factors included the presence of a urinary catheter, a vascular catheter, pressure sores and/or other wounds (e.g. leg ulcers, traumatic or surgical wounds, insertion site for gastrostomy or tracheostomy), and recent surgery, i.e. in the 30 days prior to the PPS.

2.2.6 Antimicrobial use

The Anatomical Therapeutic Chemical (ATC) classification system of the World Health Organization Collaborating Centre for Drug Statistics Methodology (WHOCC) was used to classify antimicrobial agents [6]. As in previous HALT surveys, the following antimicrobial agents had to be included: antibacterials for systemic use (ATC J01), antimycotics for systemic use (J02) and antifungals for systemic use (D01BA), antibiotics used as intestinal anti-infectives (A07AA), antiprotozoals (P01AB) and antimycobacterials (J04A) when used for treatment of mycobacteria including tuberculosis or as a reserve treatment for multidrug-resistant bacteria. Their route of administration had to be oral, parenteral (intravenous, intramuscular or subcutaneous), by inhalation or rectal. Antiviral agents for systemic use, preparations of antimicrobial agents for topical use, and antiseptic agents were excluded.

2.2.7 Healthcare-associated infections

In contrast to the previous HALT surveys, in HALT-3, data were collected not only for the HAIs associated with the current LTCF, but also for HAIs acquired in other healthcare facilities, e.g. an acute care hospital or another LTCF.

For this purpose, the term 'active HAI' (associated with a stay in a healthcare facility, e.g. LTCF or hospital) was adapted and defined as follows:

a**.** Signs/symptoms of the infection:

- are present on the survey date AND are new or acutely worse;
  OR
- were present in the two weeks (14 days) prior to the PPS AND were new or acutely worse AND the resident is (still) receiving treatment for the infection on the survey date*.

AND

b. The onset of symptoms occurred:

- more than 48 hours (i.e. day three onwards) after the resident was (re-)admitted to the current LTCF;
  OR
- less than 48 hours (i.e. presently admitted, on the day of admission, or on day two) after the resident was (re-)admitted to the current LTCF from another healthcare facility (e.g. LTCF or hospital)
  OR
  - deep and organ/space surgical site infections occurring less than 90 days after implant surgery;
    OR
  - other surgical site infections occurring less than 30 days after an operation;
    OR
  - *Clostridioides difficile* (*C. difficile)* infections occurring less than 28 days after discharge from a healthcare facility (e.g. LTCF or hospital).

** If these signs/symptoms meet the case definition for an HAI, the HAI should be recorded on the resident form. Data collectors should investigate the signs/symptoms in the preceding two weeks, e.g. from patient records or by consulting the resident's physician, if practicable.*

Most of the case definition decision algorithms used in the HALT-3 survey matched those used in HALT-2, i.e. they were based on case definitions of the United States Centers for Disease Control and Prevention (US CDC) and the Long-Term Care Special Interest Group (LTCSIG) of the Society for Healthcare Epidemiology of America (SHEA) [7].

There were three changes to the decision algorithms compared to HALT-2. Firstly, the definition of *C. difficile* infection (CDI) was adapted, to align with the definition used in the concurrent 'Point prevalence survey of healthcare-associated infections and antimicrobial use in European acute care hospitals, 2016–2017' [8]. Secondly, the definitions for surgical site infections (SSIs) were added, because the HALT-3 protocol included HAIs acquired in other healthcare facilities. These definitions were also taken from the ECDC protocol for the concurrent ECDC PPS in acute care hospitals [8]. Thirdly, a new category was added for imported HAI cases. These had been recently transferred from another healthcare facility (e.g. hospital or LTCF) and still received treatment for a stated HAI (including, but not limited to, antimicrobial agents). It is common for such residents to have insufficient documentation of signs/symptoms during their stay in the previous healthcare facility, in notes or with their caregivers. In such cases, their HAIs would not meet the criteria specified in the HALT-3 case definition algorithms, and so they would not be counted. Therefore, data collectors could add the suffix '-I' for 'imported' to the HAI code on the data collection form if they could state what the HAI was, but there was insufficient evidence to meet the HALT-3 case definitions [3, 8].

2.2.8 Antimicrobial resistance

The resident form was used to gather data on the three 'most important' isolated microorganisms, for patients identified as having an active HAI on the day of the PPS, who had a microbiological culture performed on a microbiological sample. The protocol also provided codes to report antimicrobial susceptibility testing (AST) results for selected bacterium-antimicrobial combinations (Table 2). The data collector then entered the specified antimicrobial susceptibility codes in the resident form [3]. This methodology differed from the HALT (2010) and HALT-2 (2013) methodologies, in which antimicrobial resistance (AMR) data were linked to the antimicrobial use data [1, 2].

Table 2. The antimicrobial resistance phenotypes reported for selected microorganisms in the third PPS of HAI and antimicrobial use in LTCFs, HALT-3, 2016–2017

Microorganism	Tested antibiotic[i]	Antimicrobial resistance			
Staphylococcus aureus (STAAUR)	Oxacillin (OXA)	Susceptible		Resistant	Unknown
	Glycopeptides (GLY)	Susceptible	Intermediate[ii]	Resistant	Unknown
Enterococcus* species** (ENC)	Glycopeptides (GLY)	Susceptible	Intermediate	Resistant	Unknown
Enterobacterales[iii], including: *Escherichia coli (ESCCOL)* *Klebsiella* species (KLE***) *Enterobacter* species (ENB***) *Proteus* species (PRT***) *Citrobacter* species (CIT***) *Serratia* species (SER***) *Morganella* species (MOGSPP)	Third-generation cephalosporins (3GC)	Susceptible	Intermediate	Resistant	Unknown
	Carbapenems (CAR)	Susceptible	Intermediate	Resistant	Unknown
Pseudomonas aeruginosa (PSEAER)	Carbapenems (CAR)	Susceptible	Intermediate	Resistant	Unknown
Acinetobacter baumannii (ACIBAU)	Carbapenems (CAR)	Susceptible	Intermediate	Resistant	Unknown

2.3 National PPS protocols

Four countries (France, Norway, the Netherlands and Sweden) used national protocols for PPSs in LTCFs [9-12] and two countries (Cyprus and Czechia) only collected data on parts of the HALT-3 protocol. All other countries/administrations used the HALT-3 protocol [3].

In France, the national programme of actions against HAIs foresees a national PPS of HAIs in medico-social institutions every five years [12]. Between 16 May and 30 June 2016, a PPS was conducted in general nursing homes ('Établissements d'hébergement pour personnes âgées dépendantes'[iv] or Les EHPAD). Differences with the HALT-3 protocol were that France only collected data on HAIs associated with the current LTCF, as in the HALT-2 protocol [13]. The data was collected on a selection of the institution-level local performance indicators from HALT-3 [12], and only four types of infection: urinary tract infections, respiratory tract infections (excluding common cold/pharyngitis), skin infections (including skin and soft tissue infections, wound/pressure sore infections, scabies and catheter-related infections), and gastrointestinal infections (only *C. difficile* infections).

Norway provided data from its PPS of HAIs and antimicrobial use in healthcare institutions ('Helsetjenesteassosierte infeksjoner og antibiotikabruk i helseinstitusjoner'[v] or NOIS-PIAH [9]). Nursing homes must participate in these surveys twice a year. Norway submitted data that originated from the PPS that was conducted in May 2017. NOIS-PIAH includes antimicrobial agents that are similar to the HALT-3 inclusion criteria: antibacterials for systemic use (ATC J01) and antimycotics for systemic use (J02), vancomycin for treatment of *C. difficile* (A07AA09), fidaxomicin for treatment of *C. difficile* (A07AA12), metronidazole (P01AB01) and rifampicin (J04AB02). All HAIs associated with a stay in a healthcare facility (e.g. LTCF or hospital) were included, as in HALT-3.

[i] OXA: susceptibility to oxacillin, or other marker of MRSA, such as cefoxitin, cloxacillin, dicloxacillin, flucloxacillin, meticillin; GLY: susceptibility to glycopeptides: vancomycin or teicoplanin; 3GC: susceptibility to third-generation cephalosporins: cefotaxime, ceftriaxone, ceftazidime; CAR: susceptibility to carbapenems: imipenem, meropenem, doripenem.

[ii] According to the EUCAST guidelines which applied in 2016–2017.

[iii] Antimicrobial resistance markers are not collected for other Enterobacterales (e.g. *Hafnia* spp., *Salmonella* spp., *Shigella* spp., *Yersinia* spp.).

[iv] accommodation establishments for dependent elderly people

[v] healthcare-associated infections and antibiotic use in health institutions

However, NOIS-PIAH collected aggregated ward-level HAI data only for urinary tract infections (UTIs), lower respiratory tract infections (RTIs), surgical site infections (SSIs) and skin infections (erysipelas, soft tissue infections, wound infections excluding SSIs, scabies, fungal infection, herpes simplex and herpes zoster infection). Additionally, NOIS-PIAH included a limited subset of HALT-3 institution-level data [9].

The Netherlands has a national sentinel surveillance network to monitor infectious diseases in nursing homes ('Surveillance Netwerk Infectieziekten Verpleeghuizen' or SNIV) [10], conducting PPSs of HAI and antimicrobial use in April and November of each year. The Netherlands provided data from its 2017 PPS (April and November). The SNIV protocol only recorded data on antibacterials and antimycotics. All HAIs associated with a stay in a healthcare facility (e.g. LTCF or hospital) were included, but different HAI definitions were used for sepsis/bacteraemia, lower RTIs (including pneumonia), UTIs, gastrointestinal infections (with no separate definition for *C. difficile* infections), skin infections (i.e. cellulitis/soft tissue/wound infections, herpes simplex or herpes zoster infections, and fungal infections), and bacterial conjunctivitis. As in France and Norway, SNIV only collected a subset of institution-level data [10].

As France, the Netherlands and Norway submitted data for a limited set of HAIs, data imputation was performed for the types of HAI for which data were not collected during their national PPS, using the European average (see Section 2.7, 'Data analysis').

Czechia only collected HALT-3 institutional data, excluding denominator data, during the first quarter of 2018. As a result, HAI and antimicrobial use data were not available for this report.

Cyprus collected the institutional data as in the HALT-3 protocol, including denominator data for all eligible residents such as the number of residents with at least one antimicrobial agent, and the number of residents with at least one HAI. Therefore, the prevalence of residents with at least one antimicrobial agent or at least one HAI could be calculated for Cyprus. However, as resident questionnaires were not completed, no further information on HAIs or antimicrobial prescriptions was available.

Sweden provided data from its national survey of HAIs and antimicrobial use in LTCFs, from units (wards) within mixed facilities ('Svenska HALT' [11]). Its surveillance protocol is directly based on the HALT-2 PPS methodology and incorporated into an online data entry system. Consequently, there are two discrepancies to be noted for Sweden. Firstly, Sweden only recorded HAIs associated with residence in the current LTCF. Secondly, information on AMR was linked to the data on antimicrobial use. Therefore, microbiological results were only collected when an antimicrobial agent was prescribed for the treatment of an HAI. Additionally, Sweden used a different methodology to collect HALT-3-compatible institutional data, by collecting data at four different levels. While some questions were completed by a local surveyor in a participating unit, other questions were asked to an external nurse responsible for medical coordination in a municipality. Their responses were applied to all participating units within that municipality. Similarly, another set of questions was completed by Sweden's strategic programme against antibiotic resistance ('Samverkan mot antibiotikaresistens' or Strama) groups in each county, and applied to all participating units within that county and its municipalities. Also, some questions were answered at the national level and applied to participating units [11].

Finland did not recruit residential care units for HALT-3, and all but one of its participating LTCFs were nursing care units.

Lastly, Portugal collected data at the unit (ward)-level, rather than at the LTCF-level (similar to the 'Svenska HALT', see above).

2.4 National denominators

All participating countries/administrations were requested to complete the 'European LTCF register survey', to update the data acquired for HALT-2 (2013) and/or HALT (2010) regarding the national number of LTCFs and LTCF beds, by LTCF category. The data were used to calculate the burden of HAIs and antimicrobial use in European LTCFs. In countries where an on-site assessment visit was performed, the results were discussed with the respective OCP.

The register included definitions for five types of LTCF, which are as follows:

- **General nursing home** (type A): The residents in these nursing homes need medical and/or skilled nursing care and supervision 24 hours a day. These LTCFs principally provide care to older adults with severe illnesses or injuries.
- **Specialised LTCFs** (type B): These LTCFs specialise in one specific type of care, e.g. physical impairment, chronic diseases such as multiple sclerosis, dementia, psychiatric illnesses, rehabilitation care, palliative care, intensive care, etc.
- **Residential homes** (type C): In residential homes, residents are unable to live independently. They require supervision and assistance for the activities of daily living (ADL). These LTCFs usually include personal care, housekeeping and three meals a day.

- **Mixed LTCFs** (type D): These LTCFs provide different types of care at the same facility (a mix of LTCF types A, B and C).
- **Other LTCFs** (type E): Other facilities, which are not classifiable under the above-mentioned types of LTCF.

2.5 Training

In 2012–2013, the HALT-2 management team developed a training curriculum for a one-day course for the participating LTCFs. In addition, a two-day train-the-trainers workshop was organised for the OCPs.

ECDC recommended that national/regional survey coordinators organise at least a one-day information and training session for the local LTCF staff. The HALT-2 (2013) training materials were updated to match the HALT-3 PPS methodology, including the curriculum and relevant materials. These were presented in December 2015 at a two-day train-the-trainers workshop for the OCPs. The workshop also included a presentation of the HALT-3 methodology and draft protocol, survey tools, and available training materials.

All training materials were made available on the ECDC HAI-Net extranet, in English and in an editable format. The extranet also included answers to FAQs from the OCPs and local data collectors regarding all aspects of the HALT-3 project, as well as selected FAQs from HALT (2010) and HALT-2 (2013).

In February–March 2017, ECDC organised a series of six training webinars to provide refresher training to countries/administrations planning to participate in the third and fourth PPS 'waves'. ECDC invited national teams which had already performed the HALT-3 survey to share their 'lessons learnt'. The topics of the six webinars included, 'application of case definitions', 'planning and executing a validation study' and 'potential sources of national-level data'. To support these webinars, ECDC uploaded all protocols, questionnaires, webinar presentations and webinar recordings to a new ECDC Virtual Academy (EVA) webpage [14].

2.6 Validation study

The objectives of the validation study were: a) to calculate the sensitivity and specificity of the detection of HAIs and antimicrobial use in the primary HALT-3 survey by primary data collectors at the European level, thereby enabling the adjustment of European estimates; and b) to assess the quality of selected structure and process indicators of IPC, thus contributing to the interpretation of national/European-level data. The validation study did not aim to validate the HALT-3 PPS data at national or LTCF-levels [4].

The methodology was presented to the OCPs at the train-the-trainers workshop in December 2015. It was based on the HALT-2 validation study. The adjustments aimed to minimise the burden from data collection. For example, countries could consider only including high prevalence wards, to improve the accuracy of the validity estimates. In addition, the number of questions on antimicrobial use and structure and process indicators were reduced, as the sensitivity and specificity of these data was high in HALT-2.

The validation survey had to be performed by a separate validation team which reviewed all the residents in an LTCF, on the same day that the main HALT-3 PPS was performed by the primary team of data collectors in the same LTCF. To avoid any adjustment of data by the primary team following the findings of the validation team, the two teams had to complete their forms independently. A few smaller countries anticipated that all HALT-3 data collection would be performed by the national team, and so they would not be able to recruit a national 'gold standard' validation team. Therefore, the protocol recommended that one national team member act as the primary team and another as the validation team, as a measure of inter-rater reliability (IRR).

At the European level, the minimum sample size was 1 500 residents, based on the 82% sensitivity of HAI data collection in HALT-2, a 10% false positivity rate and an estimated 4% prevalence of HAI. Therefore, ECDC recommended that each country/administration recruit at least one LTCF. The national team could choose the LTCF based on logistic convenience, but it should be neither untypically large nor small. It should also not be a notable champion in IPC and antimicrobial stewardship. In addition, the validation study sample size for countries which wished to adjust their own national estimates was also 1 500 residents.

2.7 Data analysis

PPS data were processed and analysed with Stata/SE 14.2 (StataCorp. 2015. *Stata Statistical Software: Release 14.* College Station, TX: StataCorp LLC.) and R 3.5.0 (R Foundation for Statistical Computing, Vienna, Austria). Boxes in horizontal box plots represent the median and interquartile range, with the lines above/below this range indicating the boundary 1.5 times the magnitude of the upper/lower quartiles. Values outside of these boundaries (i.e. outliers), were plotted as individual values.

2.7.1 Risk adjustment of HAI prevalence and antimicrobial use

Multivariable linear regression models were developed on a systematic sample of two-thirds of the data and validated on the other third. Two models were developed for the estimation of prevalence on the day of the survey: one for the prediction of the HAI prevalence, and another for the prevalence of antimicrobial use.

Both models included the type of LTCF, the size of LTCF, and characteristics of the LTCF resident population such as, care load indicators. Countries were excluded from the analysis if they reported data by LTCF ward without an indication of the corresponding number of LTCFs (Portugal and Sweden), or if they had incomplete care load indicators and risk factors for the entire LTCF population (France and Norway). North Macedonia and Serbia were excluded as they are not EU/EEA countries, and they did not have an LTCF sample that was representative of the country. LTCFs were also excluded if they reported an HAI prevalence of >40% or a prevalence of antimicrobial use of >60% (less than 0.2% of all participating facilities, respectively) as they were considered outliers.

After each model, the predicted prevalence (HAI or antimicrobial use prevalence) for each LTCF was acquired by multiplying the LTCF characteristics and proportions of each care load indicator among its LTCF residents, by their respective regression coefficients. Subsequently, each LTCF was classified as a 'low', 'medium' or 'high'-risk facility by using the 25th and 75th percentiles of the predicted prevalence of all LTCFs.

2.7.2 Calculation of the burden of HAIs in LTCFs

To estimate the burden of HAIs in LTCFs in the EU/EEA in terms of prevalence (total number of residents with an HAI on any given day), weighted prevalence percentages were calculated by applying the country/administration-specific prevalence to the number of occupied LTCF beds in each country/administration, and thereafter, summing up the total number of residents with HAIs in the countries/administrations that participated in HALT-3. To estimate the total number of HAIs or patients with at least one HAI for the whole EU/EEA, the average results from participating countries/administrations were applied to the national denominator data from non-participating countries/administrations. Validation study results were applied to obtain the country/administration-weighted validation-corrected HAI prevalence.

To estimate the burden of HAIs in LTCFs in the EU/EEA in terms of incidence (total number of HAIs occurring per year in LTCFs in the EU/EEA), the annual incidence of HAIs in LTCFs was estimated by multiplying the country/administration-specific prevalence by 365 days and dividing it by the duration of HAI (in days), with a correction for an average occupancy of LTCF beds of 95%, calculated from the HALT-3 denominator data. The duration of HAI was estimated by the type of HAI, by doubling the median duration from the date of HAI onset until the date of the survey in the entire HALT-3 dataset. Since parameters such as the length of stay of residents were not collected in the survey (only by approximation), the burden in terms of incidence could only be estimated for the total number of HAIs and not for the number of residents with at least one HAI per year.

To calculate confidence intervals (CIs) around EU/EEA burden estimates, the number of patients with at least one HAI (for prevalence) or the total number of HAIs (for estimated incidence) obtained from the lower and upper limits of the country/administration-specific 95% CIs were summed up and divided by the total number of occupied beds (for prevalence) or the total number of discharges (for estimated incidence) in the EU/EEA. These 'cumulative 95% CIs' (95% cCI) therefore reflect a larger, more conservative uncertainty than would be obtained by calculating 95% CIs directly on the EU/EEA totals, which is in accordance with the limitations of the prevalence measurement and the uncertainty inherent to the prevalence to incidence conversion [15].

Only general nursing homes, residential homes and mixed type facilities were included in the validation study analyses, as only these types of LTCF were included in the general analyses. Exact binomial 95% CIs were calculated for the sensitivity and specificity of data for HAIs and antimicrobial use, which are expressed as percentages.

Validation results were calculated for each country/administration, by matching patients included in the validation sample with their corresponding data collected in the primary PPS. The percentages of false positives (FPs) and false negatives (FNs) was calculated directly from these matched analyses. Several countries selected high prevalence wards for validation to improve precision, as recommended by the validation study protocol. The percentages of FPs and FNs were applied to the total national database to calculate the sensitivity and specificity for each country/administration. For correction of the EU/EEA prevalence of HAIs, the EU/EEA mean FPs and FNs were applied to the total number of patients.

The agreement between the institution-level data collected by the validation team and the primary team was measured using the Cohen's Kappa measure of concordance.

Validation study data were analysed using R 3.5.0 (R Foundation for Statistical Computing, Vienna, Austria) and the package 'epiR' version 0.9-93.

2.7.3 Definitions

The criteria defining 'eligible residents' are listed in a previous section (see Section 2.2.3, 'Eligibility of residents').

'Selected LTCFs' included all LTCFs classified as general nursing homes, residential homes or mixed LTCFs (see Section 2.1.2, 'LTCF participation'). In this report, a 'country' is defined as an EU Member State, EEA country, EU candidate country, or EU potential candidate country. The United Kingdom (UK) devolved administrations (Northern Ireland, Scotland and Wales), which independently participated in HALT-3, are reported as 'administrations'.

The crude HAI prevalence was presented as the percentage of residents with at least one HAI detected on the day of the PPS over the total number of eligible residents. Similarly, the crude antimicrobial use prevalence was defined as the percentage of residents with at least one antimicrobial agent on the day of the PPS over the total number of eligible residents. The 'median' of an indicator is the 50th percentile for that indicator in all included LTCFs in the entire dataset, e.g. the median HAI prevalence is the median of the HAI prevalence detected in all included LTCFs.

Antimicrobial resistance data presented in this report should be interpreted with caution. Access to microbiological tests and their results is limited in European LTCFs and can greatly vary between countries and even within the administrative units of one country. Therefore, AMR data collected for selected bacterium-antimicrobial combinations were combined in one composite index of AMR. This index combined the percentage of isolates non-susceptible to first-level antimicrobial resistance markers, i.e. *Staphylococcus aureus* non-susceptible to oxacillin, *Enterococcus* non-susceptible to glycopeptides, Enterobacterales non-susceptible to third-generation cephalosporins, and *Pseudomonas aeruginosa* and *Acinetobacter baumannii* non-susceptible to carbapenems.

2.7.4 Recoding of variables

The following variables were recoded before analysis:

- The origin of HAIs was recoded from 'Current LTCF' to 'Unknown' if the HAI was reported as 'imported' (infection code '-I').
- If not reported, the microorganism code for reported *C. difficile* infections was replaced by the code for *C. difficile* in the analysis. Even though the diagnosis of *C. difficile* infections can be made without a positive microbiological test, these cases are rare. The recoding resulted in the addition of two *C. difficile* microorganisms, i.e. one in Germany and one in Italy.

2.7.5 HAI data imputation

France, the Netherlands and Norway submitted data from their national surveys (see Section 2.3, 'National PPS protocols'), and according to their national PPS protocols, only a limited set of HAIs had to be collected. Using these data without any modification would have led to an underestimation of the prevalence of residents with at least one HAI in these countries, and thereby also at the EU/EEA level. Therefore, for HALT-3, we imputed the prevalence of the HAIs that were not recorded in these countries. To achieve this, UTIs were used as a reference, as they are included in the HALT-3 protocol and these national protocols. This assumed that the ratio of UTIs to other types of HAIs was relatively stable across European countries/administrations. The ratio of each type of HAI to the number of UTIs was calculated in all countries/administrations, excluding France, the Netherlands and Norway, which had national systems; and Cyprus and Czechia, which collected insufficient details on infections. These ratios were used to impute missing data on HAIs in the three countries at LTCF level, by applying the EU/EEA-level ratios to the LTCF-level UTI data, while assuming that the ratios would be stable across LTCFs and countries/administrations. The imputed values were then rounded to the nearest integer.

To calculate the prevalence of residents with at least one HAI, the total number of HAIs obtained in France, the Netherlands and Norway was divided by the average number of HAIs per resident in the other countries/administrations.

No data imputation for the origin of HAI was performed for countries that only included HAIs associated with the current LTCF (France and Sweden). Therefore, in these countries, the number of infections with the 'current LTCF' as the origin of HAI is equal to the total number of included HAIs (all HAI origins).

2.8 Outputs

2.8.1 Post-survey LTCF-level feedback reports

After each surveillance period, the OCPs received LTCF-level feedback reports for all the participating LTCFs in their country/administration. These compared each individual LTCF to LTCFs of the same type, as well as all the participating LTCFs in the country/administration.

2.8.2 Interactive database

The ECDC website contains an interactive database presenting tables, maps and figures from HALT (2010), HALT-2 (2013) and HALT-3 (2016–2017). This tool can export these outputs as PDFs and other similar formats.

2.8.3 HALT-3 report

This report summarises the methodology and the main results from HALT-3.

2.8.4 Peer-reviewed publications

In 2018, two articles reporting results from HALT-3 data have been published in peer-reviewed journals with co-authors from ECDC and countries/administrations that participated in HALT-3. The first article presents the main results from HALT-3 on the prevalence of antimicrobial use in European LTCFs, 2016–2017 [16]. The second article presents results on the prevalence of HAIs, estimated incidence, and a composite antimicrobial resistance index from both HALT-3, and the PPS of HAIs and antimicrobial use performed in European acute care hospitals 2016–2017 [15].

3 Results

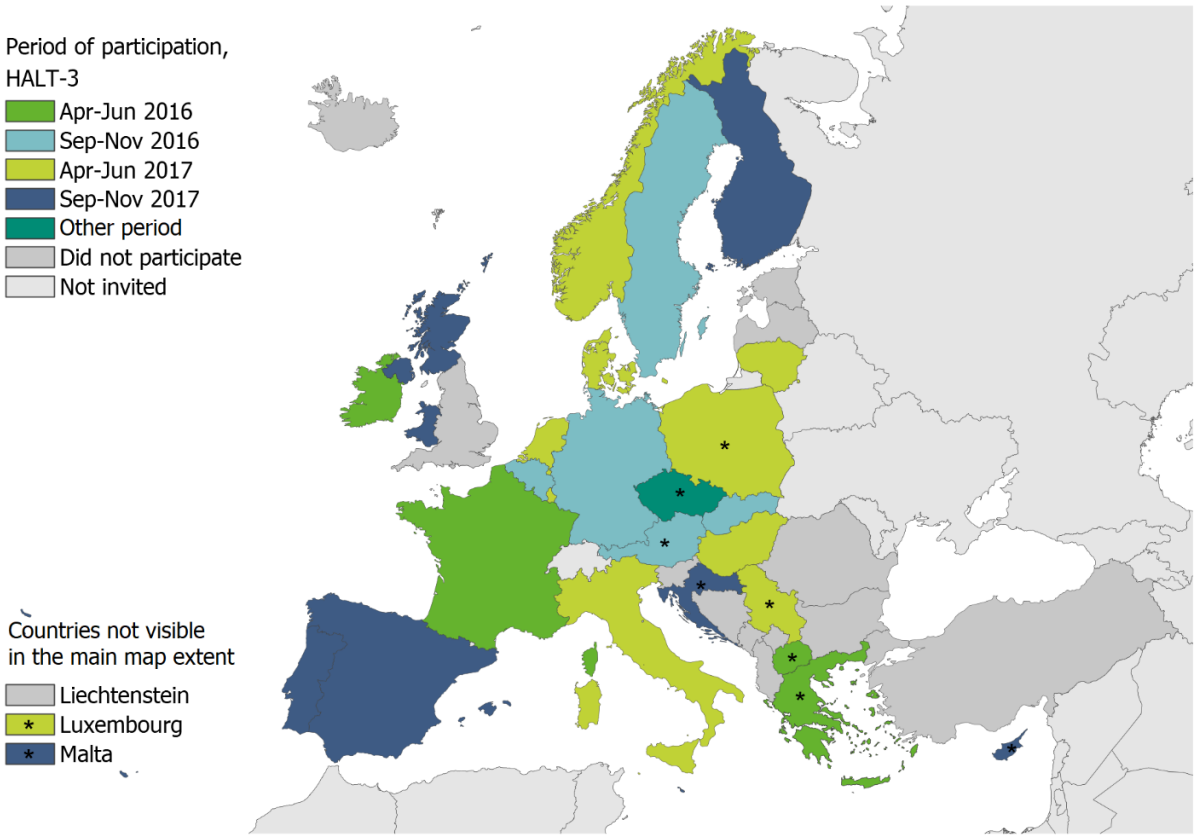
3.1 Participation

A total of 24 EU/EEA countries/administrations participated in the third PPS of HAIs and antimicrobial use in European LTCFs. Three of the four UK devolved administrations (Northern Ireland, Scotland and Wales) independently performed the PPS, and are considered separately throughout this report.

In addition to the EU/EEA countries/administrations, two EU candidate countries, i.e. North Macedonia (n=4 LTCFs) and Serbia (n=6 LTCFs) performed the survey. Results from these countries are presented separately in the tables and figures, and not included in the aggregate results presented in this report.

Most countries/administrations (n=9/26, 34.6%) performed the PPS during the fourth surveillance period, i.e. September–November 2017. Denmark and the Netherlands submitted the data collected during two surveillance periods, while Greece had LTCFs participating in all four surveillance periods. Cyprus and Czechia only collected institutional indicators in their participating LTCFs. For these two countries, data on HAIs and prescribed antimicrobial agents were not available. However, Cyprus provided denominator data, including the numbers needed to calculate the prevalence of residents with HAI or antimicrobial use. In Czechia, the institutional indicators were collected in January–March 2018 (Figure 1).

Figure 1. First period of participation[vi] in the third PPS of HAIs and antimicrobial use in European LTCFs, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample.*

Data for 3 052 LTCFs were submitted by 24 EU/EEA countries to ECDC, of which 85.7% were general nursing homes, residential homes or mixed facilities. To avoid overrepresentation, a subset of these three types of LTCF was drawn from the submitted data from eight countries (Belgium, Germany, Finland, France, Hungary, Ireland, Italy and Spain; see Section 2.2.1, 'Representativeness of national samples of LTCFs').

[vi] Denmark, Greece, the Netherlands and North Macedonia collected data in several periods. Only the first period is shown in the figure.

The final EU/EEA dataset included 117 138 residents from 2 232 LTCFs. The majority of these were general nursing homes (45.9%), mixed LTCFs (26.5%) and residential homes (8.1%) (Table 3). No sanatoria participated.

Table 3. Types and numbers of LTCFs that performed the PPS, by country/administration, HALT-3, 2016–2017

Country/Administration	N of LTCFs									
	General nursing home	Residential home	Mixed LTCF	Psychiatric LTCF	LTCF for the mentally disabled	LTCF for the physically disabled	Rehabilitation centre	Palliative care centre	Other LTCF	Total
Austria	0	7	5	0	0	0	2	0	0	14
Belgium	79	0	0	3	0	0	4	0	0	86
Croatia	0	0	8	0	0	0	0	0	0	8
Cyprus	7	0	4	1	1	0	0	0	0	13
Czechia	0	4	5	0	1	0	0	1	0	11
Denmark	0	0	95	0	0	0	0	0	0	95
Finland	148	0	1	0	8	0	0	0	0	157
France	91	0	0	0	0	0	0	0	0	91
Germany	55	15	12	1	0	0	0	0	1	84
Greece	0	0	13	0	0	0	0	0	0	13
Hungary	65	9	1	7	12	0	0	0	17	111
Ireland	75	0	34	23	31	1	5	7	9	185
Italy	61	85	50	0	1	1	10	3	4	215
Lithuania	0	0	26	0	0	0	0	0	0	26
Luxembourg	15	1	0	0	0	0	0	0	0	16
Malta	0	8	3	0	0	0	0	0	0	11
Netherlands	0	0	57	0	0	0	0	0	0	57
Norway	62	0	0	0	0	0	0	0	0	62
Poland	12	12	0	1	0	0	0	0	0	25
Portugal	0	0	132	0	0	0	124	12	0	268
Slovakia	27	0	32	1	6	0	0	3	0	69
Spain	0	0	46	0	0	0	0	0	0	46
Sweden	285	0	0	4	117	0	11	0	0	417
UK-Northern Ireland	0	15	55	0	0	0	0	0	0	70
UK-Scotland	34	17	1	0	0	0	0	0	0	52
UK-Wales	9	7	12	0	1	1	0	0	0	30
Total	**1 025**	**180**	**592**	**41**	**178**	**3**	**156**	**26**	**31**	**2 232**
%	**45.9**	**8.1**	**26.5**	**1.8**	**8.0**	**0.1**	**7.0**	**1.2**	**1.4**	**100**
North Macedonia	3	0	1	0	0	0	0	0	0	4
Serbia	0	0	6	0	0	0	0	0	0	6

LTCF categories that are highlighted in green were amalgamated in further analyses of this report; those in grey are presented individually in a separate chapter.

3.2 Results from general nursing homes, residential homes and mixed LTCFs

3.2.1 Characteristics of the selected LTCFs

General nursing homes (n=1 025), residential homes (n=275) and mixed LTCFs (n=497) were selected from the final dataset to increase homogeneity and consequently, comparability between countries. Combined, they represented 80.5% of all participating LTCFs.

Table 4 presents the total number of LTCFs and LTCF beds per country, as well as those selected for analysis. In some countries, denominator data were estimates rather than exact figures (see Section 3.2.9, 'National denominators and burden estimates of HAIs in LTCFs in the EU/EEA'). 'Good' or 'optimal' representativeness was achieved in 18 out of 26 countries/administrations (Table 4, Figure 2).

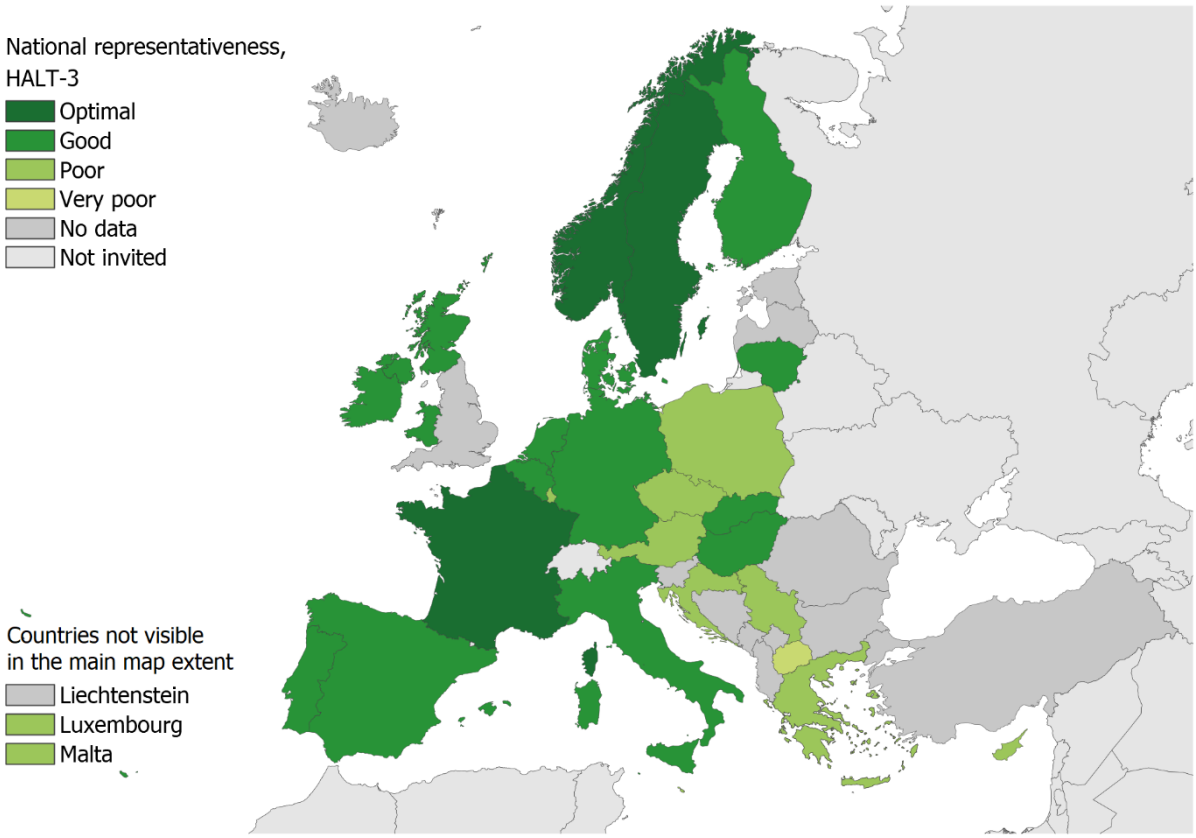
Table 4. Number of LTCFs and LTCF beds, both nationally and in LTCF categories selected for analysis, by country/administration, HALT-3, 2016–2017

Country/Administration	LTCFs			LTCF beds			National representativeness of LTCF sample***
	In the country/ administration*	Selected for inclusion in HALT-3**		In the country/ administration*	In LTCFs selected for inclusion in HALT-3**		
	N	n	%	N	n	%	
Austria	817	12	1.5	72 602	2 739	3.8	Poor
Belgium	1 559	79	5.1	146 462	18 551	12.7	Good
Croatia	325	8	2.5	37 249	1 837	4.9	Poor
Cyprus	90	11	12.2	3 436	561	16.3	Poor
Czechia	73	9	12.3	17 204	704	4.1	Poor
Denmark	827	95	11.5	42 668	3 661	8.6	Good
Finland	1 928	149	7.7	50 373	7 092	14.1	Good
France	9 744	91	0.9	687 936	29 977	4.4	Optimal
Germany	10 389	82	0.8	852 849	11 440	1.3	Good
Greece	263	13	4.9	10 849	874	8.1	Poor
Hungary	1 177	75	6.4	57 929	30 002	51.8	Good
Ireland	578	109	18.9	30 531	11 318	37.1	Good
Italy	3 219	196	6.1	186 872	25 959	13.9	Good
Lithuania	154	26	16.9	11 722	3 581	30.5	Good
Luxembourg	62	16	25.8	6 966	1 643	23.6	Poor
Malta	41	11	26.8	5 035	2 566	51.0	Poor
Netherlands	700	57	8.1	92 000	5 808	6.3	Good
Norway	907	62	6.8	39 583	2 925	7.4	Optimal
Poland	373	24	6.4	17 291	2 580	14.9	Poor
Portugal	181	360	50.3	4 723	8 400	56.2	Good
Slovakia	677	59	8.7	27 497	6 119	22.3	Good

Country/Administration	LTCFs			LTCF beds			National representativeness of LTCF sample***
	In the country/ administration*	Selected for inclusion in HALT-3**		In the country/ administration*	In LTCFs selected for inclusion in HALT-3**		
	N	n	%	N	n	%	
Spain	5 387	46	0.9	372 306	8 716	2.3	Good
Sweden	2 300	285	12.4	93 000	6 085	6.5	Optimal
UK-Northern Ireland	445	70	15.7	15 924	2 912	18.3	Good
UK-Scotland	873	52	6.0	37 746	2 674	7.1	Good
UK-Wales	795	28	3.5	24 646	1 144	4.6	Good
North Macedonia	21	4	19.0	1 166	302	25.9	Very poor
Serbia	ND	6	-	ND	1 249	-	Poor

** Denominator data from the European LTCF register (see Section 3.2.9, 'National denominators and burden estimates of HAIs in LTCFs in the EU/EEA') ** Aggregated data from general nursing homes, residential homes and mixed LTCFs; *** Based on criteria specified in the HALT-3 protocol (see also Section 2.2.1, 'Representativeness of national samples of LTCFs'); ND: no data; -: not available*

Figure 2. Country/administration representativeness of LTCF sample, HALT-3, 2016–2017



About half (50.9%) of all included LTCFs were publicly owned, while 28.0% and 21.1% were non-profit or for-profit organisations, respectively. The median size of the LTCFs (total number of beds) was 43 beds (mean=62.6 beds). The low median number of beds in Sweden (11.0 beds) and Portugal (26.0 beds) is due to the fact that these countries recruited LTCF units rather than entire LTCFs. Even disregarding these two countries, the median national LTCF size varied considerably: from 33 beds in Denmark and Finland to 211 beds in Croatia (Table 5).

The median percentage of single rooms among the total number of rooms was 89.5%. Similarly, the median percentage of all beds that were in single rooms was 80.2%. In 10 countries/administrations (Belgium, Denmark, Finland, Luxembourg, the Netherlands, Norway, Sweden, and the three participating UK devolved administrations) the median percentage was >90% (Table 5, Figure 3). Conversely, >95% of rooms had more than one bed in Cyprus, Czechia, Greece, Hungary and Poland. France did not collect data on the number of single rooms.

Fewer than half of all beds in participating LTCFs were in single rooms with individual toilet and washing facilities (median percentage 46.0%; Table 5), although all beds had these facilities in the participating LTCFs in Denmark, Norway, Sweden and UK-Scotland.

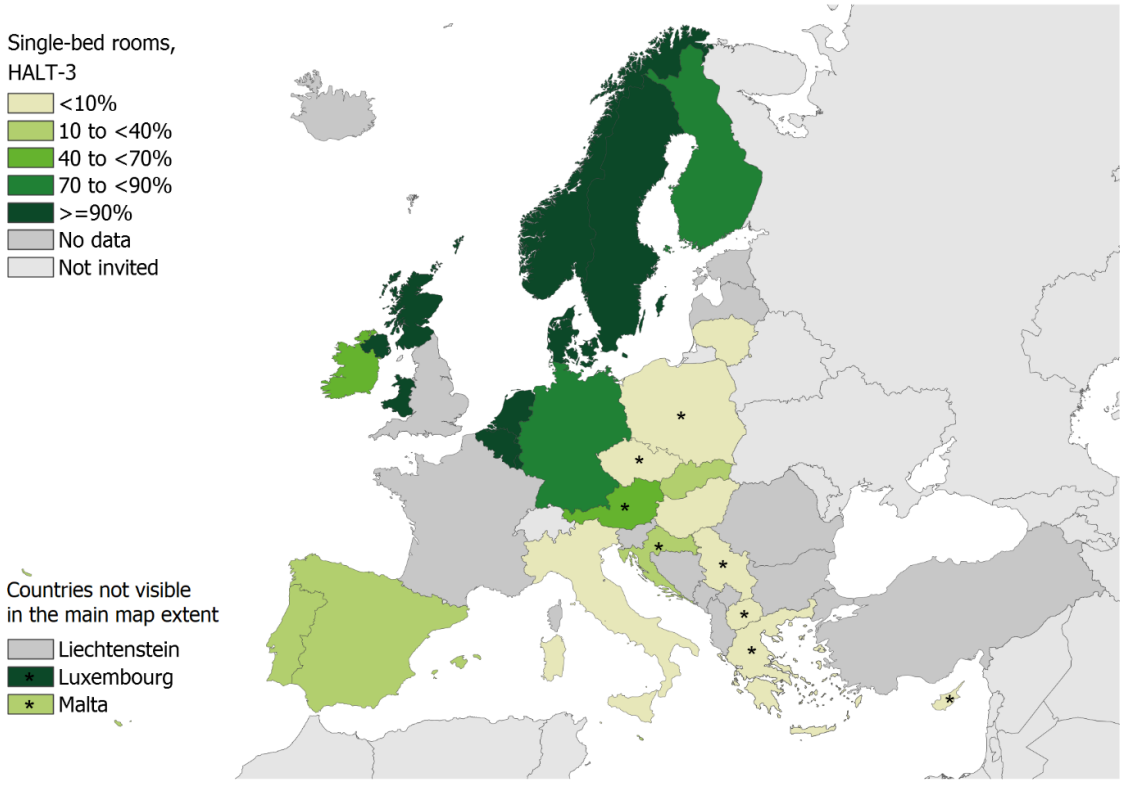
Table 5. Ownership, size and percentage of single rooms in the included LTCFs, by country/administration, HALT-3, 2016–2017

Country/Administration	Included LTCFs	Public LTCFs	Size of included LTCFs (n of beds)				Median % of single rooms among the total N of LTCF beds	Median % of single rooms with individual toilet and washing facilities among the total N of LTCF beds
	n	%	Mean	P25	Median	P75	%	%
Austria*	12	75.0	179.2	93.0	102.0	243.5	46.7	45.5
Belgium	79	31.6	112.4	81.0	102.0	133.0	93.2	92.4
Croatia*	8	87.5	229.6	130.0	211.0	328.5	28.5	17.6
Cyprus*	11	27.3	37.5	22.0	36.0	52.0	0.0	0.0
Czechia*	9	55.6	69.6	40.0	79.0	100.0	2.5	1.7
Denmark	95	100.0	38.5	24.0	33.0	48.0	100.0	100.0
Finland	149	77.2	41.4	24.0	33.0	46.0	88.9	81.5
France[a]	91	50.0	80.1	58.0	80.0	90.0	-	-
Germany	82	4.9	87.8	60.0	84.0	106.0	75.3	66.7
Greece*	13	7.7	67.2	50.0	70.0	74.0	3.5	3.5
Hungary	75	56.0	107.3	51.0	90.0	137.0	3.0	0.0
Ireland	109	56.9	57.6	33.0	50.0	73.0	46.7	21.4
Italy	196	53.6	62.9	32.5	50.5	74.5	9.5	3.7
Lithuania	26	80.8	137.7	40.0	118.0	214.0	6.4	0.0
Luxembourg*	16	56.3	102.7	72.5	94.5	144.5	97.6	60.4
Malta*	11	72.7	233.3	123.0	148.0	215.0	10.8	10.8
Netherlands[a]	57	-	101.9	40.0	72.0	133.0	97.0	35.6
Norway[a]	62	96.7	47.2	24.0	35.0	61.0	100.0	100.0
Poland*	24	75.0	106.2	43.5	82.5	134.5	2.8	1.1

Country/Administration	Included LTCFs	Public LTCFs	Size of included LTCFs (n of beds)				Median % of single rooms among the total N of LTCF beds	Median % of single rooms with individual toilet and washing facilities among the total N of LTCF beds
	n	%	Mean	P25	Median	P75	%	%
Portugal	132	6.1	29.2	20.0	26.0	30.0	13.3	13.3
Slovakia	59	55.9	93.3	54.0	83.0	132.0	10.2	0.0
Spain	46	78.3	164.3	69.0	121.0	209.0	15.0	7.4
Sweden[a]	285	NA	15.2	9.0	11.0	16.0	100.0	100.0
UK-Northern Ireland	70	21.4	41.6	28.0	36.5	56.0	100.0	7.7
UK-Scotland	52	21.2	51.4	29.5	46.0	69.5	100.0	100.0
UK-Wales	28	7.7	37.5	29.0	36.5	45.0	100.0	88.5
Total	**1 797**	**50.9**	**62.7**	**24.0**	**44.0**	**80.0**	**80.2**	**46.0**
North Macedonia*	4	50.0	75.5	17.5	30.0	133.5	4.0	4.0
Serbia*	6	100.0	208.2	78.0	219.5	286.0	5.7	2.1

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); -: not available.*

Figure 3. Median percentage of beds in the included LTCFs that were in single-bed rooms, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample.*

3.2.2 Characteristics of the eligible LTCF population

A total of 102 301 residents were eligible for inclusion in the survey i.e. residents living full-time (24 hours a day) in the LTCF and present at 8:00 am on the day of the PPS and not discharged from the LTCF at the time of the survey. The three countries that recruited the most residents were Italy (n=11 417 residents), Belgium (n=8 206) and Hungary (n=7 670).

For Czechia and Norway, no information was available regarding resident demographics, care load indicators and/or risk factors. For France, no information was available regarding care load indicators and the presence of wounds (pressure sores or others) (Tables 6 and 7).

Table 6. Total number of eligible LTCF residents, percentage of male residents and residents older than 85 years in the included LTCFs, by country/administration, HALT-3, 2016–2017

Country/Administration	N of eligible LTCF residents	% of male residents				% of residents older than 85 years			
		Mean	P25	Median	P75	Mean	P25	Median	P75
Austria*	2 065	28.6	20.5	25.8	35.6	45.6	42.6	47.9	63.3
Belgium	8 206	25.3	21.6	24.8	27.5	56.2	51.9	55.7	62.7
Croatia*	1 607	25.5	21.4	24.7	29.8	39.7	32.8	42.0	44.8
Cyprus*	312	29.4	26.7	30.0	37.0	53.4	15.4	61.7	82.4
Czechia*	-	-	-	-	-	-	-	-	-
Denmark	3 346	36.6	28.2	35.7	43.3	52.8	42.0	54.2	60.9
Finland	5 914	30.3	23.8	30.0	36.7	53.1	44.6	53.8	61.3
France[a]	6 957	26.8	21.3	26.6	31.6	61.5	54.7	63.8	73.0
Germany	6 705	26.7	19.0	24.8	30.2	51.0	45.6	53.0	59.3
Greece*	812	30.2	23.2	31.0	37.5	50.0	43.5	48.0	57.1
Hungary	7 670	31.8	20.7	29.2	41.0	29.5	15.7	31.0	43.2
Ireland	5 613	36.5	29.6	35.5	45.8	48.7	38.8	48.0	56.1
Italy	11 417	28.3	21.3	27.6	35.2	52.7	44.9	54.1	63.6
Lithuania	3 438	46.0	28.6	50.6	59.9	19.1	1.5	16.0	29.2
Luxembourg*	1 616	25.5	22.8	25.6	27.1	57.7	48.8	57.6	66.0
Malta*	2 485	24.1	21.7	26.0	27.6	53.1	46.5	53.3	59.2
Netherlands[a]	4 547	30.7	22.8	28.6	38.9	46.7	37.2	48.6	57.7
Norway[a]	2 447	-	-	-	-	-	-	-	-
Poland*	2 281	33.3	23.7	32.7	44.1	32.5	21.6	30.6	41.1
Portugal	3 633	40.3	30.8	41.9	50.0	30.1	20.8	27.5	37.5
Slovakia	5 091	31.4	22.0	29.0	36.4	29.3	21.1	29.6	37.5
Spain	6 808	37.8	32.0	37.7	42.6	44.5	33.3	45.2	55.7
Sweden[a]	3 604	34.0	22.2	33.3	42.9	58.3	45.5	60.0	70.6
UK-Northern Ireland	2 614	33.0	23.3	32.3	40.7	43.9	35.7	44.4	58.3
UK-Scotland	2 147	31.8	22.4	28.9	39.4	45.7	38.8	44.9	55.1
UK-Wales	966	27.5	17.1	25.0	31.9	51.4	40.2	55.8	62.7

Country/Administration	N of eligible LTCF residents	% of male residents				% of residents older than 85 years			
		Mean	P25	Median	P75	Mean	P25	Median	P75
Total	**102 301**	**32.2**	**23.1**	**30.0**	**40.0**	**48.6**	**37.5**	**50.0**	**61.5**
North Macedonia*	294	36.5	30.6	35.8	42.5	13.5	7.9	15.3	19.2
Serbia*	1 168	28.6	25.3	26.9	29.1	32.1	23.7	29.2	42.3

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); -: not available.*

Age and gender

The mean percentage of LTCF residents who were male was 32.2%. The median percentage of male residents in participating LTCFs was lower than 30% in nine of the 26 countries (Table 6).

The median overall percentage of residents older than 85 years was 50.0%. The lowest percentages were in Lithuania, Portugal and Slovakia where a median of 16.0%, 27.5% and 29.6% of all residents were older than 85 years old, respectively. In Cyprus, France and Sweden, 60% or more of the residents were over 85 years of age (Table 6).

Care load indicators and risk factors

The distribution of care load indicators and risk factors in the total eligible population for the survey is presented in Tables 7 and 8.

Table 7. Distribution of care load indicators in the included LTCFs, by country/administration, HALT-3, 2016–2017

Country/ Administration	Care load indicators											
	% of residents with incontinence (urine and/or faeces)				% of disoriented residents (in time and/or space)				% of residents with impaired mobility (wheelchair-user or bedridden)			
	Mean	P25	Median	P75	Mean	P25	Median	P75	Mean	P25	Median	P75
Austria*	72.3	64.2	71.5	77.3	69.0	63.9	69.6	71.9	53.8	37.0	53.2	74.6
Belgium	55.1	45.2	53.1	66.1	53.9	43.5	53.8	65.3	38.2	32.5	37.5	45.6
Croatia*	45.6	35.4	42.4	63.6	26.2	11.4	23.9	38.9	23.1	11.7	23.0	31.0
Cyprus*	54.5	7.7	68.2	95.7	35.3	9.5	25.0	68.2	47.0	21.3	40.0	76.5
Czechia*	-	-	-	-	-	-	-	-	-	-	-	-
Denmark	65.9	56.3	68.4	75.7	42.6	11.5	48.4	62.9	36.7	28.6	36.7	44.4
Finland	85.7	80.0	88.2	94.7	77.7	66.7	82.2	93.3	50.6	35.4	50.0	61.4
France[a]	-	-	-	-	-	-	-	-	-	-	-	-
Germany	70.5	58.0	74.1	83.3	56.7	47.1	57.1	63.8	45.6	39.5	46.6	52.8
Greece*	80.2	69.7	80.0	93.9	48.7	34.7	44.1	65.3	39.8	26.5	31.3	53.0
Hungary	53.9	36.1	54.3	69.6	39.3	21.1	35.7	50.0	42.2	29.4	44.4	55.6
Ireland	60.5	54.7	63.6	71.4	53.1	43.6	53.8	65.4	46.5	36.0	47.2	57.8
Italy	76.3	66.7	79.2	90.0	64.5	53.4	66.7	75.7	70.4	60.0	72.5	83.3

Country/ Administration	Care load indicators											
	% of residents with incontinence (urine and/or faeces)				% of disoriented residents (in time and/or space)				% of residents with impaired mobility (wheelchair-user or bedridden)			
	Mean	P25	Median	P75	Mean	P25	Median	P75	Mean	P25	Median	P75
Lithuania	34.8	15.0	35.4	50.0	48.7	25.2	43.1	77.3	30.7	9.5	25.1	48.3
Luxembourg*	60.5	53.7	66.1	71.2	52.2	41.3	55.7	63.0	46.2	30.5	52.3	64.4
Malta*	50.8	42.3	49.5	53.7	26.6	11.5	25.8	45.7	38.0	30.0	37.0	44.8
Netherlands[a]	57.9	48.4	58.6	70.3	69.2	55.6	68.2	85.3	43.3	33.3	43.0	54.0
Norway[a]	-	-	-	-	-	-	-	-	-	-	-	-
Poland*	73.6	57.3	77.0	89.4	52.8	41.2	52.5	63.6	66.0	44.5	68.7	86.6
Portugal	79.7	71.4	84.0	90.0	64.8	52.8	66.7	78.3	80.6	71.9	85.7	92.9
Slovakia	70.8	56.7	71.6	80.9	47.1	30.5	45.5	60.6	37.1	26.1	33.3	46.7
Spain	57.8	48.8	57.1	71.4	45.0	34.2	46.6	54.5	48.0	37.7	51.2	66.7
Sweden[a]	60.1	44.4	61.1	77.8	57.6	37.5	57.1	77.8	41.9	27.3	42.2	55.6
UK-Northern Ireland	63.5	53.8	66.1	80.7	56.2	36.0	59.2	73.2	44.6	29.5	48.8	61.5
UK-Scotland	66.9	58.7	67.9	74.8	71.3	62.6	71.9	80.0	48.3	39.8	50.0	60.0
UK-Wales	70.5	61.1	73.2	84.2	65.3	55.8	68.7	80.7	66.7	54.9	78.7	85.1
Total	**67.0**	**54.4**	**69.3**	**83.3**	**58.0**	**42.9**	**59.3**	**75.0**	**50.2**	**33.3**	**48.8**	**66.7**
North Macedonia*	33.5	7.5	31.2	59.6	28.0	17.5	35.0	38.6	24.6	5.0	20.8	44.2
Serbia*	58.2	43.2	57.8	70.4	32.8	22.6	35.0	37.0	48.7	33.8	47.3	62.8

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); -: not available.*

There was a large inter-country variability for most care load indicators. Almost half of all residents had impaired mobility (wheelchair-user or bedridden; overall median: 48.8%) with the lowest prevalence in Croatia (23.0%) and Lithuania (25.1%), and the highest in Portugal (85.7%) and UK-Wales (78.7%). The overall median prevalence of residents with incontinence was 69.3%. Incontinence was most commonly reported by participating LTCFs in Finland (88.2%), Portugal (84.0%) and Greece (80.0%), and most infrequently reported by Malta (49.5%), Croatia (42.4%) and Lithuania (35.4%). Disorientation was reported for an overall median of 59.3% residents, varying from 23.9% in Croatia to 82.2% in Finland.

The overall median percentages of both vascular catheter use and recent surgery were 0.0%. Both these risk factors were more frequently present in the Spanish LTCF residents (5.8% and 5.4%, respectively), owing to the inclusion of more post-acute (step-down) facilities in the autonomous region of Catalonia. A urinary catheter was present in a median of 5.6% residents, ranging from 1.1% in France to 13.0% in Portugal.

The overall median prevalence of pressure sores and wounds (other than pressure sores) was 3.5% and 6.5%, respectively. The prevalence of both wound groups was high in Portugal (12.5% and 10.5%, respectively) and Spain (11.3% and 17.2%, respectively). Pressure sores were commonly reported in Italy (9.0%), while 'other wounds' were frequently reported in Denmark (10.3%), Luxembourg (14.9%) and Austria (16.6%).

Table 8. Distribution of risk factors in the included LTCFs, by country/administration, HALT-3, 2016–2017

Country/Administration	% of residents with a urinary catheter				% of residents with a vascular catheter				% of residents with pressure sore(s)				% of residents with other wound(s)				% of residents with recent surgery (past 30 days)			
	Mean	P25	Median	P75	Mean	P25	Median	P75	Mean	P25	Median	P75	Mean	P25	Median	P75	Mean	P25	Median	P75
Austria*	10.5	6.2	7.8	15.4	3.1	0.2	1.9	4.2	4.2	2.4	4.3	5.7	15.5	6.9	16.6	20.3	1.1	0.4	1.0	1.1
Belgium	3.1	1.2	2.5	4.7	0.3	0.0	0.0	0.0	3.5	1.2	2.4	5.1	9.4	5.8	8.5	13.0	1.0	0.0	0.8	1.6
Croatia*	3.1	2.2	3.1	3.9	0.0	0.0	0.0	0.0	3.3	1.8	2.2	4.3	3.1	1.8	2.7	3.9	1.4	0.1	0.9	2.8
Cyprus*	9.0	5.0	9.1	10.0	0.4	0.0	0.0	0.0	5.0	0.0	5.9	7.7	1.1	0.0	0.0	2.3	3.9	0.0	0.0	6.4
Czechia*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Denmark	9.5	4.2	8.3	13.0	0.3	0.0	0.0	0.0	3.8	0.0	3.2	5.7	11.2	6.4	10.3	13.9	1.7	0.0	0.0	2.9
Finland	4.1	0.0	3.0	5.7	0.1	0.0	0.0	0.0	5.0	0.0	3.3	7.4	5.6	0.0	3.7	7.7	0.7	0.0	0.0	0.0
France[a]	1.6	0.0	1.1	2.5	3.4	0.0	1.8	4.5	-	-	-	-	-	-	-	-	0.8	0.0	0.0	1.3
Germany	8.0	4.5	7.3	11.8	0.3	0.0	0.0	0.0	4.0	2.1	3.6	5.8	7.5	4.2	5.8	10.8	1.3	0.0	1.1	2.1
Greece*	13.7	8.5	10.7	14.7	0.3	0.0	0.0	0.0	5.9	2.7	4.3	9.2	2.2	0.0	1.4	2.1	0.8	0.0	0.0	0.0
Hungary	2.1	0.0	1.3	2.7	0.0	0.0	0.0	0.0	2.2	0.0	1.3	3.4	2.9	0.0	1.9	3.9	0.7	0.0	0.0	1.0
Ireland	7.0	3.5	5.6	9.9	0.3	0.0	0.0	0.0	3.7	0.0	2.0	4.5	9.3	4.2	7.7	12.9	1.6	0.0	0.0	1.8
Italy	15.2	5.2	9.0	18.5	5.6	0.0	2.5	7.1	11.2	4.4	9.0	14.9	11.2	3.6	7.8	14.4	2.2	0.0	0.0	1.8
Lithuania	1.0	0.0	0.2	1.4	0.2	0.0	0.0	0.0	1.8	0.0	0.7	2.6	1.0	0.0	0.0	2.0	0.4	0.0	0.0	0.5
Luxembourg*	5.3	2.4	5.6	7.9	0.7	0.0	0.0	1.2	2.6	1.9	2.7	3.6	14.1	9.1	14.9	18.3	1.5	0.6	1.2	1.7
Malta*	3.0	1.4	2.4	3.9	0.0	0.0	0.0	0.0	2.7	0.8	2.3	4.7	3.0	0.0	3.3	4.7	0.4	0.0	0.0	0.9
Netherlands[a]	6.3	2.9	5.2	9.5	0.1	0.0	0.0	0.0	6.1	2.3	4.5	7.8	10.3	5.7	8.3	13.0	3.7	0.0	1.4	3.4
Norway[a]	9.4	3.3	9.0	12.9	-	-	-	-	-	-	-	-	-	-	-	-	3.9	0.0	2.1	5.1
Poland*	18.2	3.2	8.4	21.3	4.3	0.0	0.0	7.1	8.6	4.3	7.6	11.6	5.6	1.8	3.5	8.6	1.0	0.0	0.0	1.3

Country/Administration	% of residents with a urinary catheter				% of residents with a vascular catheter				% of residents with pressure sore(s)				% of residents with other wound(s)				% of residents with recent surgery (past 30 days)			
	Mean	P25	Median	P75	Mean	P25	Median	P75	Mean	P25	Median	P75	Mean	P25	Median	P75	Mean	P25	Median	P75
Portugal	15.9	6.7	13.0	21.1	1.8	0.0	0.0	0.0	13.8	7.1	12.5	20.0	13.4	5.0	10.5	19.0	0.9	0.0	0.0	0.0
Slovakia	4.8	0.7	2.3	4.8	0.0	0.0	0.0	0.0	4.1	1.2	2.5	6.0	4.2	0.5	2.6	6.1	1.1	0.0	0.0	1.5
Spain	6.8	1.6	5.3	10.5	10.9	0.5	5.8	14.4	11.3	5.9	11.3	14.8	16.0	5.8	17.2	21.3	7.3	0.8	5.4	10.0
Sweden[a]	10.4	0.0	10.0	15.4	0.2	0.0	0.0	0.0	4.1	0.0	0.0	7.1	9.9	0.0	9.1	14.3	2.4	0.0	0.0	0.0
UK-Northern Ireland	5.2	0.0	4.6	7.7	0.2	0.0	0.0	0.0	3.0	0.0	1.6	5.9	5.7	1.6	4.4	8.6	0.8	0.0	0.0	0.0
UK-Scotland	7.8	4.9	8.0	10.6	0.1	0.0	0.0	0.0	3.8	0.0	2.7	5.3	7.3	2.3	5.6	10.0	0.2	0.0	0.0	0.0
UK-Wales	7.1	3.1	6.3	9.2	0.0	0.0	0.0	0.0	4.1	0.0	3.4	6.1	5.3	2.2	4.4	7.7	1.5	0.0	0.0	3.3
Total	**8.4**	**1.4**	**5.6**	**11.1**	**1.5**	**0.0**	**0.0**	**0.0**	**5.9**	**0.0**	**3.5**	**8.3**	**8.8**	**2.3**	**6.5**	**12.5**	**1.7**	**0.0**	**0.0**	**1.7**
North Macedonia*	3.5	0.0	1.3	6.9	0.1	0.0	0.0	0.2	6.3	1.3	3.9	11.3	0.3	0.0	0.0	0.7	0.2	0.0	0.0	0.5
Serbia*	8.5	4.3	5.2	7.4	0.3	0.0	0.0	0.0	2.8	1.6	3.5	3.8	3.4	0.4	2.3	6.0	0.6	0.0	0.5	1.1

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); -: not available.*

3.2.3 Medical care and coordination in the LTCFs

Medical care for residents was provided by general practitioners (GPs) in 65.3% of the LTCFs, and by employed medical staff in 21.0% of the LTCFs. Both types of medical care were provided in 13.7% of the included LTCFs. In Croatia and Sweden, medical care was only provided by GPs (Table 9).

Table 9. Medical care providers and coordination in the included LTCFs, by country/administration, HALT-3, 2016–2017

Country/Administration	Medical care providers			Coordinating physicians			
	GPs only	Employed medical staff	Both GPs and employed medical staff	None	Internal	External	Internal and external
	% of LTCFs with this type of medical care**			% of LTCFs with this type of medical coordination**			
Austria*	33.3	58.3	8.3	0.0	91.7	0.0	8.3
Belgium	93.7	0.0	6.3	2.5	40.5	51.9	5.1
Croatia*	100.0	0.0	0.0	0.0	25.0	62.5	12.5
Cyprus*	9.1	45.5	45.5	9.1	9.1	54.5	27.3
Czechia*	44.4	33.3	22.2	33.3	22.2	11.1	33.3
Denmark	86.3	0.0	13.7	98.9	1.1	0.0	0.0
Finland	4.7	71.1	24.2	2.0	21.5	65.1	11.4
France[a]	-	-	-	5.5	94.5	0.0	0.0
Germany	98.8	0.0	1.2	82.9	1.2	15.9	0.0
Greece*	0.0	53.8	46.2	0.0	46.2	46.2	7.7
Hungary	82.7	12.0	5.3	16.0	5.3	78.7	0.0
Ireland	56.9	22.9	20.2	35.8	13.8	43.1	7.3
Italy	65.8	14.8	19.4	31.6	34.7	27.0	6.6
Lithuania	61.5	0.0	38.5	19.2	19.2	50.0	11.5
Luxembourg*	73.3	13.3	13.3	66.7	13.3	20.0	0.0
Malta*	45.5	9.1	45.5	27.3	18.2	18.2	36.4
Netherlands[a]	0.0	76.2	23.8	0.0	90.5	4.8	4.8
Norway[a]	0.0	78.7	21.3	34.4	44.3	14.8	6.6
Poland*	45.8	25.0	29.2	8.3	45.8	41.7	4.2
Portugal	31.1	41.7	27.3	6.1	63.6	19.7	10.6
Slovakia	94.9	1.7	3.4	0.0	6.8	93.2	0.0
Spain	8.7	67.4	23.9	4.3	69.6	26.1	0.0
Sweden[a]	100.0	0.0	0.0	0.0	0.0	100.0	0.0
UK-Northern Ireland	97.1	0.0	2.9	28.6	0.0	71.4	0.0
UK-Scotland	98.1	0.0	1.9	40.0	0.0	60.0	0.0
UK-Wales	96.4	0.0	3.6	35.7	3.6	57.1	3.6

Country/Administration	Medical care providers			Coordinating physicians			
	GPs only	Employed medical staff	Both GPs and employed medical staff	None	Internal	External	Internal and external
	% of LTCFs with this type of medical care**			% of LTCFs with this type of medical coordination**			
Total	**65.3**	**21.0**	**13.7**	**22.2**	**25.5**	**47.8**	**4.5**
North Macedonia*	50.0	0.0	50.0	0.0	50.0	50.0	0.0
Serbia*	16.7	33.3	50.0	0.0	83.3	0.0	16.7

** Poor or very poor national representativeness of the LTCF sample; ** Missing values excluded from calculation; [a] Data extracted from national surveys (see Section 2, 'Methodology'); GP: general practitioner; -: not available.*

There was no medical doctor in charge of coordinating medical activities in 22.2% percent of all LTCFs. In the LTCFs that reported having a medical doctor in charge of coordination activities (77.8%), the medical doctor was from the LTCF itself (33.0%), or external to the LTCF (61.2%), or worked both internally and externally (5.8%). All LTCFs in Austria, Croatia, Greece, the Netherlands, Slovakia and Sweden had a coordinating medical doctor (Table 9).

3.2.4 Infection prevention and control (IPC) practices and resources in the LTCFs

Each participating LTCF was asked whether there was availability of a person with training in IPC, an IPC committee, and/or formal access to help and advice from an external IPC team. LTCFs were included in the analyses presented in Table 10 if they provided answers to all three questions. Therefore, LTCFs from France were not included, as the French national protocol only collected data on the availability of a person with training in IPC.

The majority of LTCFs (n=1 138 / 1 602; 71.0%) had at least one person with IPC training at their disposal (Table 10). These persons were reported to be a nurse (50.2%), a doctor (5.3%), or a team of both (44.5%). They were most commonly based at the reporting LTCFs (43.0%), while a sizeable minority were based externally (32.9%) or worked both internally and externally (24.1%).

Table 10. Overview of infection prevention and control (IPC) structures and protocols available in the included LTCFs, by country/administration, HALT-3, 2016–2017

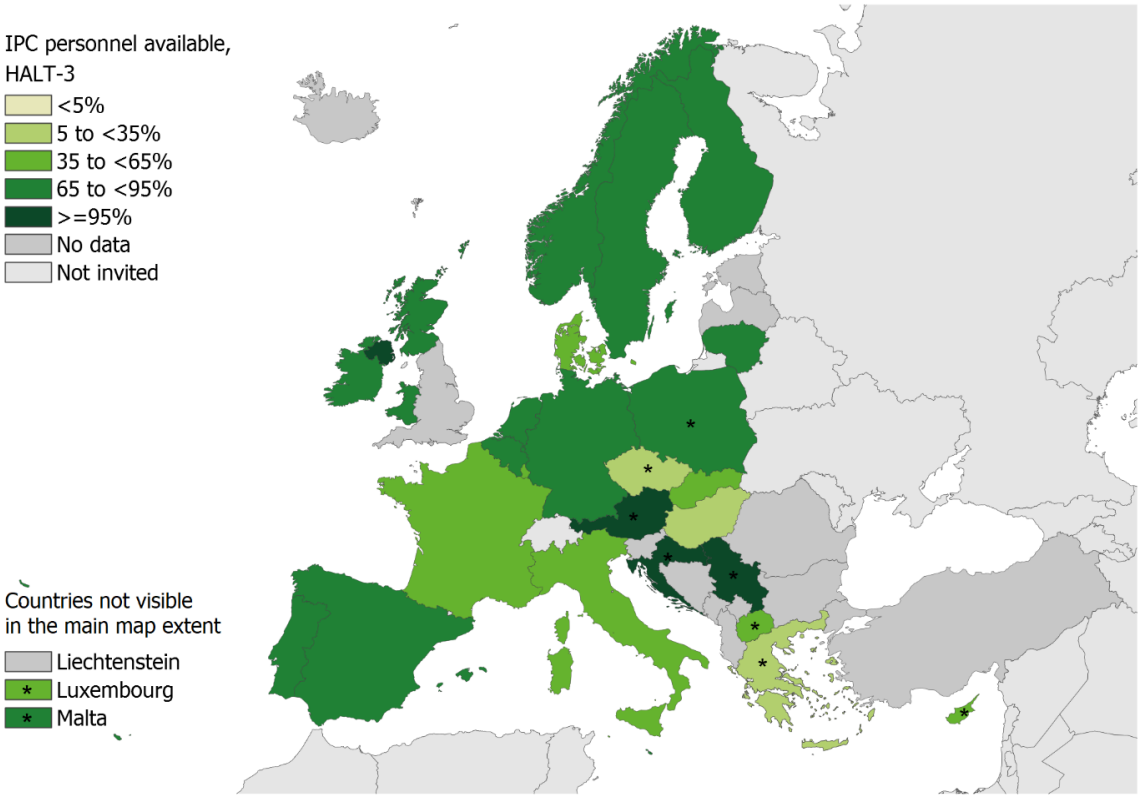
Country/ Administration	IPC structures				IPC protocols					
	Included LTCFs**	Person with IPC training	IPC committee	Expert IPC advice	Included LTCFs**	MRSA and/or other MDROs	Hand hygiene	Management of urinary catheters	Management of vascular catheters	Management of enteral feeding
	N	%	%	%	N	%	%	%	%	%
Austria*	12	100.0	83.3	100.0	12	100.0	100.0	100.0	100.0	91.7
Belgium	77	68.8	39.0	77.9	73	100.0	100.0	60.3	28.8	43.8
Croatia*	8	100.0	100.0	100.0	7	100.0	100.0	100.0	28.6	42.9
Cyprus*	11	36.4	9.1	81.8	10	20.0	60.0	0.0	20.0	20.0
Czechia*	9	22.2	22.2	77.8	9	44.4	77.8	88.9	33.3	77.8
Denmark	95	56.8	31.6	97.9	95	98.9	98.9	98.9	92.6	68.4
Finland	146	93.8	34.9	100.0	142	98.6	98.6	78.9	56.3	59.9
France[a]	0	-	-	-	0	-	-	-	-	-

Country/ Administration	IPC structures				IPC protocols					
	Included LTCFs**	Person with IPC training	IPC committee	Expert IPC advice	Included LTCFs**	MRSA and/or other MDROs	Hand hygiene	Management of urinary catheters	Management of vascular catheters	Management of enteral feeding
	N	%	%	%	N	%	%	%	%	%
Germany	81	87.7	79.0	84.0	80	100.0	100.0	95.0	50.0	92.5
Greece*	13	23.1	0.0	92.3	13	0.0	23.1	7.7	7.7	7.7
Hungary	75	21.3	1.3	84.0	75	76.0	98.7	82.7	34.7	66.7
Ireland	103	75.7	59.2	91.3	101	100.0	100.0	99.0	50.5	94.1
Italy	194	50.5	27.3	78.9	194	73.7	99.0	97.4	94.8	93.8
Lithuania	26	73.1	3.8	96.2	26	3.8	84.6	30.8	26.9	23.1
Luxembourg*	15	60.0	13.3	33.3	16	87.5	93.8	37.5	25.0	37.5
Malta*	11	90.9	27.3	100.0	9	100.0	100.0	100.0	55.6	77.8
Netherlands[a]	21	85.7	90.5	90.5	57	38.6	38.6	38.6	35.1	29.8
Norway[a]	59	91.5	35.6	74.6	60	96.7	98.3	96.7	93.3	95.0
Poland*	24	66.7	50.0	54.2	24	66.7	100.0	75.0	62.5	54.2
Portugal	131	88.5	87.8	80.9	128	68.8	94.5	81.3	58.6	60.2
Slovakia	59	44.1	0.0	100.0	59	30.5	61.0	57.6	33.9	52.5
Spain	45	84.4	64.4	86.7	44	95.5	88.6	79.5	77.3	81.8
Sweden[a]	240	69.6	35.0	69.6	247	96.4	100.0	88.7	72.9	83.0
UK-Northern Ireland	70	95.7	12.9	98.6	69	95.7	98.6	95.7	40.6	75.4
UK-Scotland	52	75.0	28.8	98.1	45	88.9	100.0	93.3	24.4	62.2
UK-Wales	25	92.0	24.0	92.0	28	92.9	100.0	85.7	28.6	78.6
Total	**1 602**	**71.0**	**39.1**	**84.6**	**1 623**	**83.2**	**93.9**	**83.2**	**60.0**	**71.7**
North Macedonia*	4	50.0	25.0	100.0	4	25.0	50.0	25.0	25.0	25.0
Serbia*	6	100.0	100.0	100.0	6	50.0	83.3	66.7	0.0	33.3

** Poor or very poor national representativeness of the LTCF sample; ** Only LTCFs with complete data for IPC structures and protocols were included in the table; [a] Data extracted from national surveys (see Section 2, 'Methodology'); -: not available; MRSA: meticillin-resistant Staphylococcus aureus; MDRO: multidrug-resistant organism.*

Figure 4 shows the availability of a person with IPC training within the LTCFs, by country (all data considered). The participating LTCFs in Czechia, Greece and Hungary had limited access to such personnel.

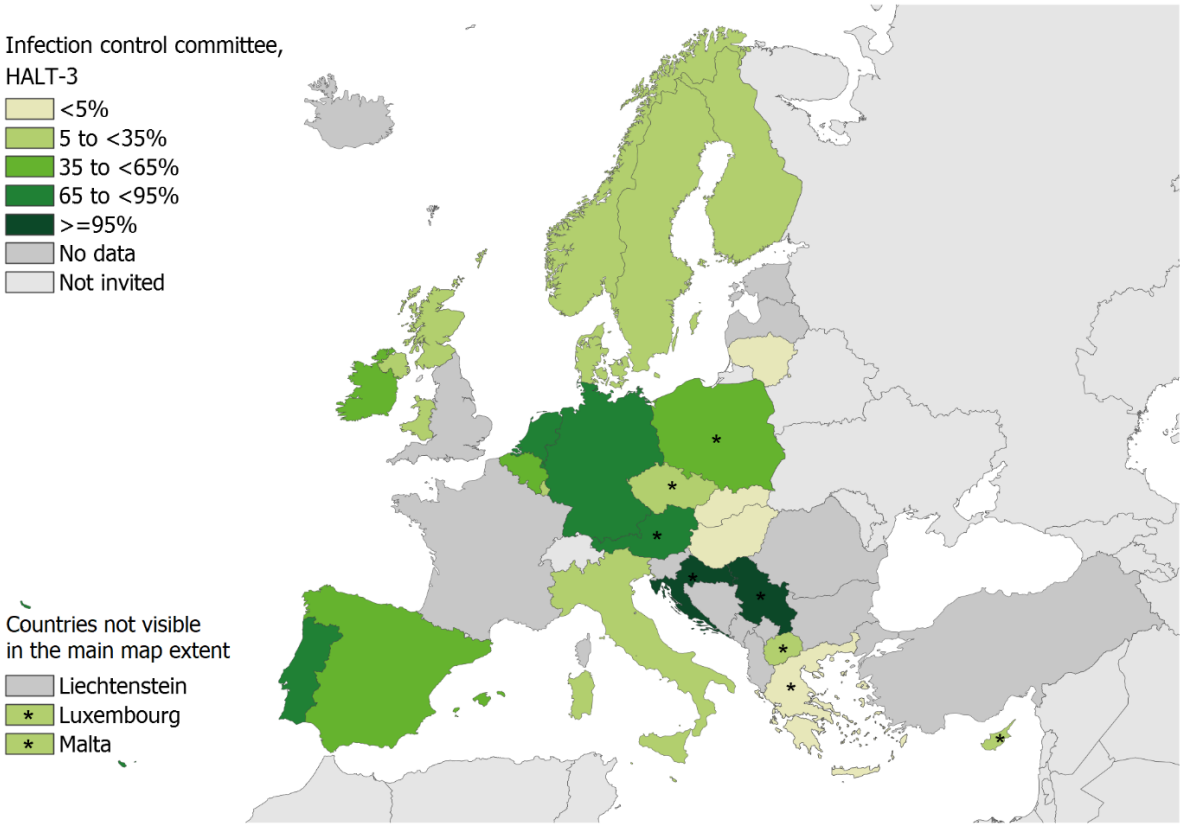
Figure 4. Percentage of included LTCFs with at least one person trained in infection prevention and control, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample.*

An IPC committee was in place in 39.1% of the LTCFs. These committees had 3.8 meetings per year on average (n=597; 30 missing) with a range from 0–50 meetings per year. Figure 5 presents the percentage of LTCFs with an IPC committee by country (all data considered). None of the LTCFs in Greece and Slovakia had an IPC committee in place, while in Croatia all the LTCFs had an IPC committee.

Figure 5. Percentage of included LTCFs with an infection prevention and control (IPC) committee, HALT-3, 2016–2017



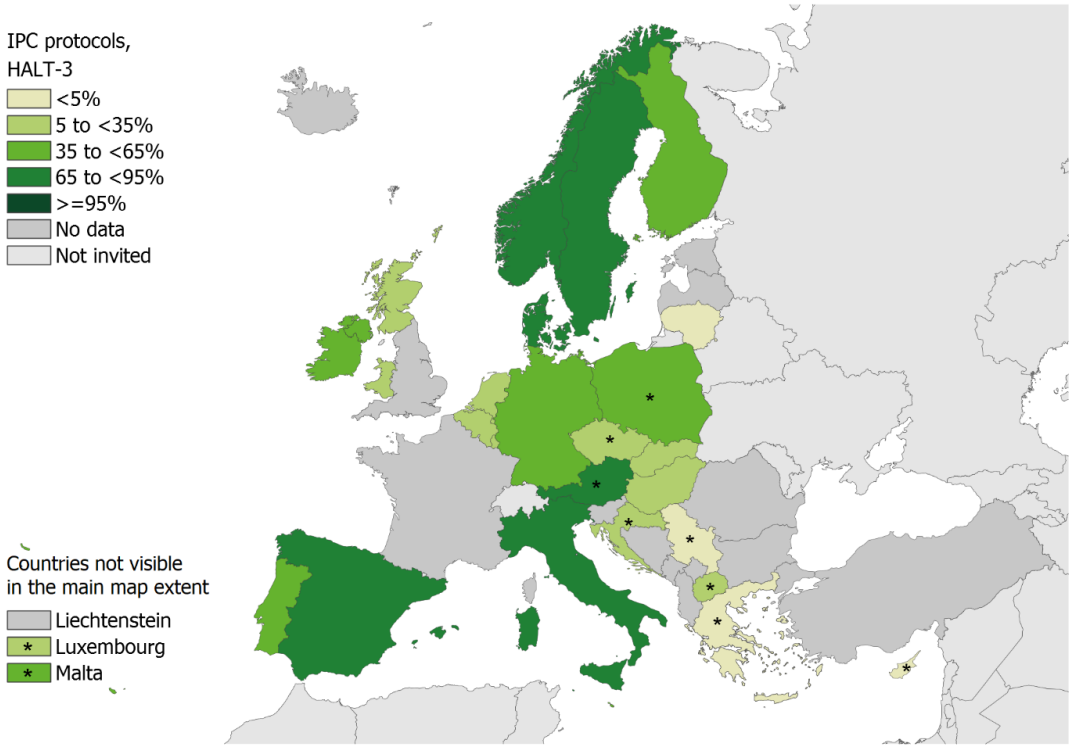
** Poor or very poor national representativeness of the LTCF sample.*

During the analysis of the availability of five written IPC protocols identified at LTCF level (management of MRSA and/or other MDROs; observance of hand hygiene; management of urinary catheters; management of vascular catheters; and management of enteral feeding), LTCFs were included if they had provided answers regarding all five protocols (n=1 623; Table 10). In total, 802 (49.4%) LTCFs reported having all five protocols in place, while 76 (4.7%) LTCFs had none of the five written protocols (Figure 6).

The three most commonly available protocols were those for hand hygiene (93.9%), the management of meticillin-resistant *Staphylococcus aureus* (MRSA) and/or other multidrug-resistant organisms (MDROs) (83.2%), and the management of urinary catheters (83.2%). The two least common were those for enteral feeding (71.7%) and the management of vascular catheters/lines (60.0%) (Table 10).

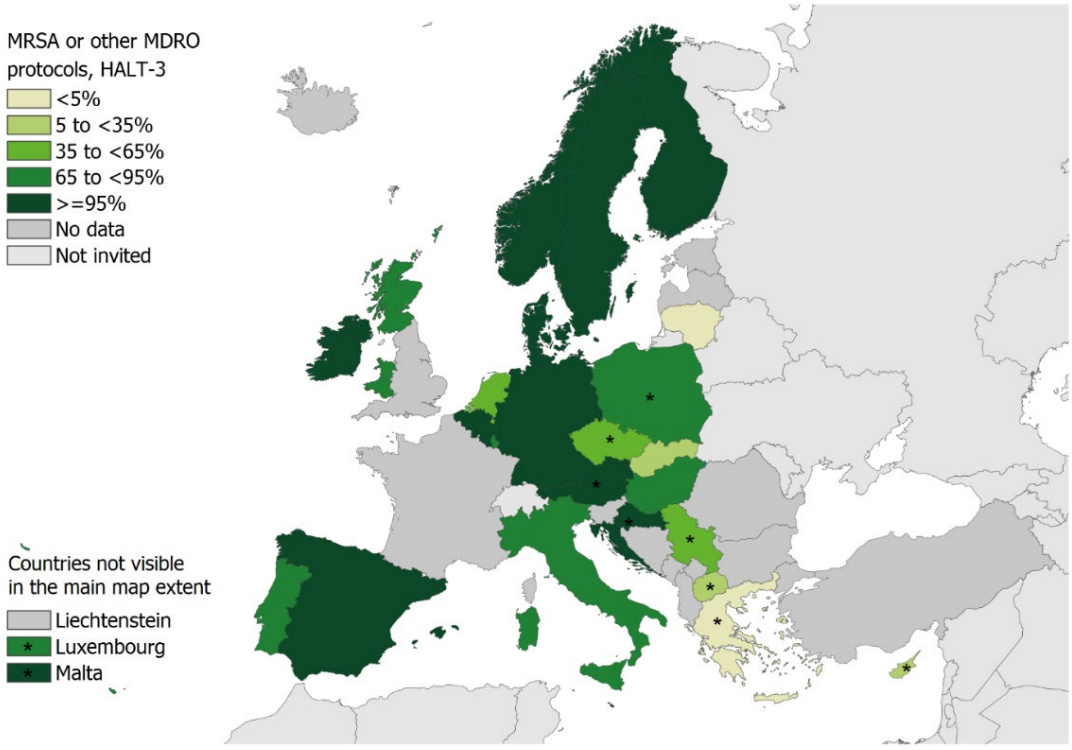
While in 12 countries, >95.0% of LTCFs reported having a written protocol for the management of MRSA and/or other MDROs, having such a protocol was the least commonly reported by LTCFs in Cyprus (20.0%), Lithuania (3.8%), and Greece (0.0%; Figure 7).

Figure 6. Percentage of included LTCFs with written protocols for all five selected infection prevention and control (IPC) protocols, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample; The five selected protocols are: the management of meticillin-resistant Staphylococcus aureus and/or other multidrug-resistant organisms (MRSA/MDRO), urinary catheters, vascular catheters/lines, enteral feeding, and hand hygiene.*

Figure 7. Percentage of LTCFs with written IPC protocols for MRSA and/or other MDRO, HALT-3, 2016–2017**



** Poor or very poor national representativeness of the LTCF sample. ** Unlike Table 8, this figure includes all LTCFs that provided a response to this question (n=1 670).*

Table 11. Infection prevention and control practices present in the included LTCFs, by country/administration, HALT-3, 2016–2017

Country/ Administration	N of LTCFs	IPC training of nursing and paramedical staff	IPC training of GPs and medical staff	Development of care protocols	Registration of residents colonised/infected with MDROs	Designation of a responsible staff for reporting and managing outbreaks	Feedback on surveillance results to the nursing/medical staff of the LTCF	Supervision of disinfection and sterilisation of medical/care materials	Decision on isolation and additional precautions for MDRO-colonised residents	Offer of annual immunisation for flu to all residents	Organisation, control, feedback on hand hygiene (on a regular basis)	Organisation, control, feedback of surveillance/audit of IPC policies and procedures	None of these elements
		%	%	%	%	%	%	%	%	%	%	%	%
Austria*	12	100.0	41.7	91.7	100.0	100.0	91.7	91.7	100.0	100.0	100.0	91.7	0.0
Belgium	79	89.9	34.2	82.3	88.6	74.7	49.4	43.0	93.7	96.2	73.4	26.6	0.0
Croatia*	8	62.5	0.0	100.0	87.5	87.5	62.5	75.0	100.0	100.0	37.5	50.0	0.0
Cyprus*	11	27.3	9.1	27.3	9.1	18.2	9.1	9.1	36.4	81.8	54.5	9.1	18.2
Czechia*	9	33.3	33.3	44.4	44.4	55.6	44.4	22.2	44.4	88.9	44.4	11.1	11.1
Denmark	95	36.8	0.0	56.8	40.0	34.7	13.7	15.8	43.2	94.7	33.7	6.3	5.3
Finland	149	84.6	28.9	89.9	63.1	65.1	55.0	52.3	96.6	99.3	54.4	51.0	0.0
France[a]	-	-	-	-	-	-	-	-	-	-	-	-	-
Germany	82	96.3	58.5	92.7	75.6	82.9	52.4	63.4	91.5	79.3	82.9	48.8	1.2
Greece*	13	61.5	30.8	7.7	38.5	76.9	23.1	30.8	61.5	100.0	15.4	7.7	0.0
Hungary	75	61.3	8.0	60.0	26.7	70.7	21.3	73.3	61.3	96.0	64.0	34.7	1.3
Ireland	103	87.4	15.5	76.7	56.3	90.3	74.8	48.5	89.3	96.1	77.7	57.3	1.0
Italy	196	66.8	19.9	87.2	49.0	31.6	34.7	60.7	85.7	93.9	48.5	29.1	0.5
Lithuania	26	50.0	0.0	84.6	11.5	53.8	26.9	0.0	7.7	96.2	46.2	23.1	0.0
Luxembourg*	15	60.0	6.7	80.0	26.7	46.7	40.0	26.7	93.3	100.0	73.3	33.3	0.0
Malta*	11	90.9	18.2	90.9	63.6	63.6	63.6	63.6	54.5	100.0	63.6	72.7	0.0
Netherlands[a]	22	9.1	86.4	77.3	86.4	86.4	36.4	9.1	100.0	-	63.6	77.3	0.0
Norway[a]	61	55.7	18.0	86.9	72.1	59.0	82.0	27.9	65.6	98.4	29.5	24.6	0.0
Poland*	24	91.7	54.2	70.8	62.5	75.0	50.0	91.7	66.7	66.7	79.2	58.3	0.0
Portugal	132	87.9	54.5	84.1	81.8	78.0	58.3	88.6	96.2	95.5	62.9	47.7	0.8
Slovakia	59	30.5	11.9	39.0	16.9	81.4	5.1	88.1	45.8	93.2	52.5	16.9	0.0
Spain	45	77.8	71.1	95.6	80.0	86.7	73.3	82.2	97.8	93.3	73.3	55.6	0.0
Sweden[a]	267	80.5	74.5	69.7	83.5	58.4	55.4	37.8	92.5	99.3	73.8	71.5	0.0
UK-Northern Ireland	70	100.0	2.9	88.6	41.4	97.1	25.7	81.4	90.0	100.0	91.4	88.6	0.0

Country/ Administration	N of LTCFs	IPC training of nursing and paramedical staff	IPC training of GPs and medical staff	Development of care protocols	Registration of residents colonised/infected with MDROs	Designation of a responsible staff for reporting and managing outbreaks	Feedback on surveillance results to the nursing/medical staff of the LTCF	Supervision of disinfection and sterilisation of medical/care materials	Decision on isolation and additional precautions for MDRO-colonised residents	Offer of annual immunisation for flu to all residents	Organisation, control, feedback on hand hygiene (on a regular basis)	Organisation, control, feedback of surveillance/audit of IPC policies and procedures	None of these elements
		%	%	%	%	%	%	%	%	%	%	%	%
UK-Scotland	52	76.9	11.5	73.1	15.4	84.6	26.9	28.8	55.8	94.2	51.9	55.8	3.8
UK-Wales	28	100.0	10.7	71.4	28.6	85.7	42.9	42.9	57.1	92.9	71.4	57.1	0.0
Total	**1 644**	**74.3**	**34.0**	**76.9**	**59.7**	**65.9**	**46.0**	**52.9**	**80.8**	**93.9**	**62.3**	**46.5**	**0.9**
North Macedonia*	4	50.0	50.0	75.0	25.0	50.0	25.0	25.0	25.0	50.0	75.0	25.0	0.0
Serbia*	6	100.0	50.0	33.3	66.7	83.3	66.7	100.0	66.7	66.7	83.3	66.7	0.0

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); IPC: infection prevention and control; GP: general practitioner; MDRO: multidrug-resistant organism; Org.: organisation; -: not available.*

The most common IPC practices reported by LTCFs were, 'offer of annual immunisation for flu to all residents' (93.9%), 'decision on isolation and additional precautions for MDRO-colonised residents' (80.8%), 'development of care protocols' (76.9%) and 'IPC training of nursing and paramedical staff' (74.3%); whereas the least common practice was 'IPC training of GPs and medical staff' (34.0%).

Hand hygiene in the LTCFs

Almost all (93.9%) LTCFs reported having a written hand hygiene protocol (Table 10). The most commonly reported hand hygiene method was disinfection with an alcohol solution (70.3%; Table 12). All LTCFs in Austria and Luxembourg reported this to be their main hand hygiene method. Overall, fewer LTCFs reported hand washing with water and an antiseptic soap (15.2%) or non-antiseptic soap (14.5%). However, at the country level, hand washing with soap and water was more frequently reported than disinfection with alcohol solution in 8/26 countries/administrations (Cyprus, Hungary, Lithuania, the Netherlands, Slovakia and the three participating UK devolved administrations; Table 12).

Almost all the LTCFs had access to alcohol rub solutions (97.7%) and liquid soap (99.3%), while alcohol wipes were less common (23.8%). About 7.4% of the LTCFs reported that they still had bar soap in clinical areas (Table 12).

Almost two-thirds (66.0%) of the responding LTCFs had provided hand hygiene training in the year prior to the survey, although this varied between countries from 9.1% in Cyprus to 100.0% in Austria (Table 12).

Table 12. Hand hygiene methods, products and training in the included LTCFs, by country/administration, HALT-3, 2016–2017

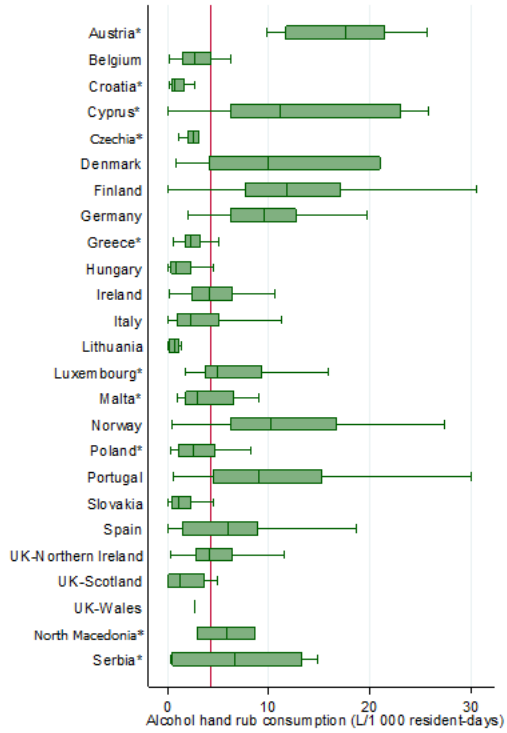
Country/Administration	Hand hygiene method				Hand hygiene products					Hand hygiene training	
	N of LTCFs	Disinfection with alcohol solution	Washing with water and non-antiseptic soap	Washing with water and antiseptic soap	N of LTCFs	Alcohol rub solution	Wipes (alcoholic)	Liquid soap (antiseptic/other)	Bar soap in clinical areas	N of LTCFs	Training in the previous year
		%	%	%		%	%	%	%		%
Austria*	12	100.0	0.0	0.0	12	100.0	50.0	100.0	0.0	12	100.0
Belgium	77	92.2	7.8	0.0	77	100.0	46.8	98.7	5.2	78	69.2
Croatia*	8	75.0	12.5	12.5	8	100.0	12.5	100.0	25.0	8	75.0
Cyprus*	9	0.0	44.4	55.6	11	90.9	36.4	100.0	18.2	11	9.1
Czechia*	9	66.7	0.0	33.3	9	100.0	22.2	88.9	0.0	9	66.7
Denmark	95	97.9	1.1	1.1	95	100.0	30.5	100.0	0.0	95	29.5
Finland	148	95.9	4.1	0.0	146	100.0	9.6	100.0	0.7	149	74.5
France[a]	-	-	-	-	-	-	-	-	-	-	-
Germany	81	96.3	1.2	2.5	81	100.0	17.3	100.0	0.0	82	97.6
Greece*	13	46.2	30.8	23.1	12	83.3	25.0	91.7	66.7	13	15.4
Hungary	73	16.4	1.4	82.2	75	89.3	5.3	100.0	12.0	75	85.3
Ireland	102	76.5	15.7	7.8	101	100.0	44.6	100.0	1.0	103	91.3
Italy	194	59.8	26.3	13.9	190	95.3	4.2	98.9	1.6	195	44.6
Lithuania	26	42.3	50.0	7.7	26	100.0	34.6	100.0	0.0	26	38.5
Luxembourg*	16	100.0	0.0	0.0	15	100.0	26.7	100.0	0.0	16	56.3
Malta*	11	81.8	0.0	18.2	11	100.0	90.9	100.0	0.0	11	63.6
Netherlands[a]	22	31.8	63.6	4.5	22	100.0	4.5	100.0	0.0	22	40.9
Norway[a]	60	70.0	30.0	0.0	61	100.0	37.7	98.4	0.0	61	54.1
Poland*	21	61.9	4.8	33.3	24	100.0	45.8	100.0	16.7	24	70.8
Portugal	131	76.3	10.7	13.0	130	98.5	13.1	97.7	36.9	130	80.0
Slovakia	59	32.2	0.0	67.8	59	91.5	42.4	100.0	40.7	59	54.2
Spain	44	65.9	22.7	11.4	42	97.6	7.1	100.0	11.9	44	72.7
Sweden[a]	249	94.0	6.0	0.0	256	100.0	10.5	98.8	0.8	214	59.8
UK-Northern Ireland	70	28.6	44.3	27.1	70	100.0	72.9	100.0	1.4	70	91.4
UK-Scotland	52	15.4	38.5	46.2	47	80.9	57.4	100.0	6.4	50	66.0
UK-Wales	28	14.3	25.0	60.7	25	100.0	32.0	100.0	4.0	28	82.1

Country/Administration	Hand hygiene method				Hand hygiene products					Hand hygiene training	
	N of LTCFs	Disinfection with alcohol solution	Washing with water and non-antiseptic soap	Washing with water and antiseptic soap	N of LTCFs	Alcohol rub solution	Wipes (alcoholic)	Liquid soap (antiseptic/other)	Bar soap in clinical areas	N of LTCFs	Training in the previous year
		%	%	%		%	%	%	%		%
Total	**1 610**	**70.3**	**14.5**	**15.2**	**1 605**	**97.7**	**23.8**	**99.3**	**7.4**	**1 585**	**66.0**
North Macedonia*	4	0.0	75.0	25.0	4	100.0	75.0	100.0	100.0	4	50.0
Serbia*	6	33.3	0.0	66.7	6	100.0	16.7	100.0	16.7	6	66.7

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); Only LTCFs with complete hand hygiene method, products and training data were included; -: not available.*

Among the 1 054 LTCFs that reported data, the median use of alcohol-based hand rub in the previous year, was 4.3 litres per 1 000 resident-days (Figure 8). The mean use was 32.7 litres per 1 000 resident-days. There was considerable variation in the reported use of alcohol-based hand rub, from a quarter of LTCFs reporting usage of more than 188 litres per 1 000 resident-days each year to another quarter reporting no usage of such rubs. Austria reported the highest consumption of alcohol-based hand rub in the LTCFs (17.6 litres per 1 000 resident-days), and Lithuania reported the lowest consumption (0.7 litres per 1 000 resident-days). Data were not available for France, the Netherlands and Sweden.

Figure 8. Alcohol-based hand rub use (litres per 1 000 resident-days) in the previous year in the included LTCFs, by country/administration, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample; Red vertical line: crude median (4.3 L/1 000 resident-days), no outliers; Box plots indicate the 25th, 50th (median) and 75th percentiles; Adjacent lines indicate the boundary 1.5× the interquartile range; The national survey protocols of France, the Netherlands and Sweden do not collect these data.*

3.2.5 Antimicrobial stewardship resources

The institutional questionnaire verified the presence of 10 elements of antimicrobial stewardship in the LTCFs. Overall, 28.5% of the 1 639 LTCFs with data on antimicrobial stewardship had none of these elements present (Table 13; Figure 9). This was most commonly reported by the participating LTCFs in Denmark (88.4%), Germany (90.2%) and Lithuania (92.3%). Overall, there were 588 (35.9%) LTCFs that reported having half of the 10 elements, 151 (9.2%) LTCFs reported having nine or more elements, and 9 (0.5%) LTCFs reported having all 10 elements.

The two most commonly present antimicrobial stewardship elements were a 'therapeutic formulary, comprising a list of antibiotics' (45.6%) and 'written guidelines for appropriate antimicrobial use (good practice) in the LTCF' (39.4%). In Greece, 76.9% participating LTCFs had 'a system that requires permission from a designated person(s) for prescribing of restricted antimicrobials not included in local formulary', whereas overall only 9.6% of the LTCFs participating in HALT-3 had such a system.

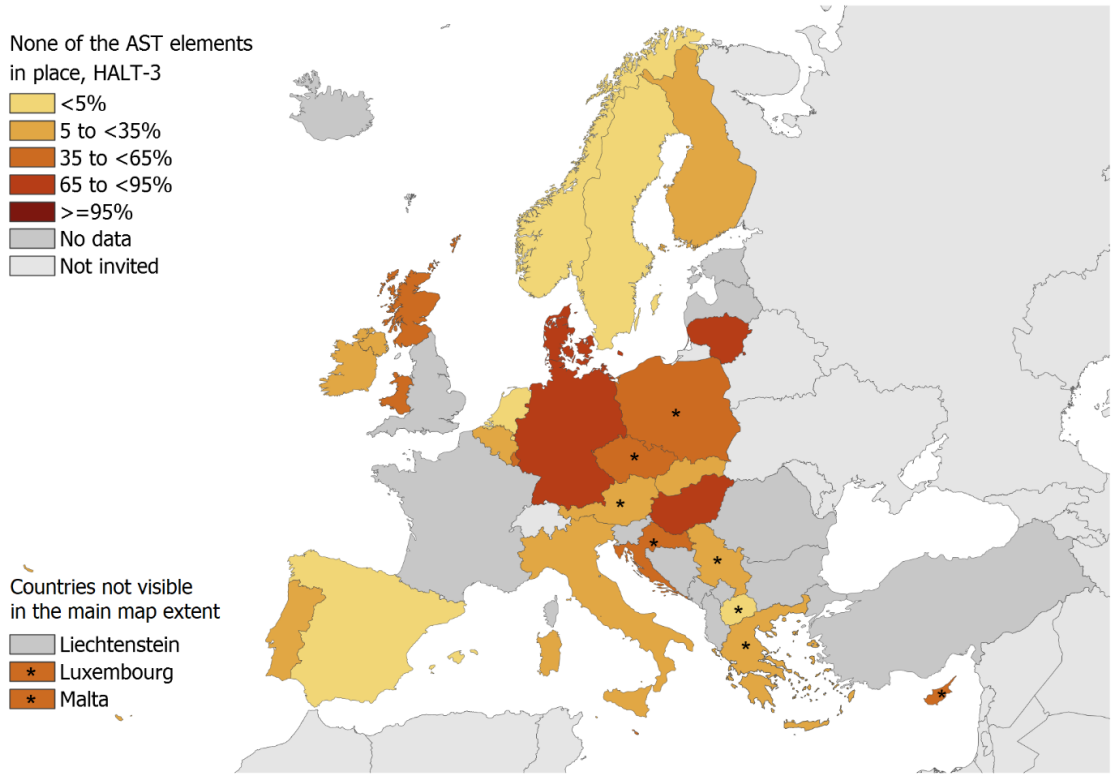
Table 13. Antimicrobial stewardship elements present in the included LTCFs, by country/administration, HALT-3, 2016–2017

Country/ Administration	Included LTCFs	Antimicrobial committee	Training on appropriate prescribing	Written guidelines for appropriate antimicrobial use	Data on annual antimicrobial consumption	Reminder of the importance of samples	Local antimicrobial resistance profiles	Permission for prescribing restricted antimicrobials	Advice from a pharmacist	Therapeutic formulary	Feedback to GPs on antimicrobial consumption	None of these elements
	N	%	%	%	%	%	%	%	%	%	%	%
Austria*	12	8.3	16.7	75.0	41.7	16.7	83.3	16.7	16.7	75.0	41.7	8.3
Belgium	78	9.0	6.4	34.6	20.5	10.3	7.7	1.3	23.1	50.0	15.4	25.6
Croatia*	8	0.0	0.0	12.5	25.0	25.0	12.5	12.5	12.5	12.5	37.5	62.5
Cyprus*	11	0.0	9.1	18.2	18.2	0.0	0.0	9.1	9.1	0.0	0.0	63.6
Czechia*	9	11.1	11.1	11.1	11.1	44.4	0.0	22.2	11.1	0.0	0.0	55.6
Denmark	95	0.0	0.0	2.1	0.0	0.0	0.0	0.0	8.4	2.1	1.1	88.4
Finland	147	0.0	4.8	13.6	10.9	62.6	13.6	3.4	27.2	40.1	1.4	21.1
France[a]	-	-	-	-	-	-	-	-	-	-	-	-
Germany	82	0.0	2.4	1.2	1.2	0.0	4.9	0.0	2.4	0.0	1.2	90.2
Greece*	13	0.0	0.0	0.0	0.0	0.0	0.0	76.9	0.0	0.0	0.0	23.1
Hungary	72	1.4	2.8	8.3	11.1	2.8	1.4	1.4	2.8	5.6	6.9	75.0
Ireland	106	1.9	7.5	38.7	12.3	24.5	13.2	7.5	46.2	22.6	20.8	26.4
Italy	193	2.6	9.8	21.2	30.6	6.7	14.0	36.3	40.9	78.8	28.5	14.0
Lithuania	26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7	92.3
Luxembourg*	16	0.0	0.0	6.3	0.0	0.0	0.0	0.0	37.5	0.0	0.0	62.5
Malta*	11	0.0	9.1	45.5	0.0	9.1	0.0	36.4	36.4	18.2	18.2	36.4
Netherlands[a]	21	100.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
Norway[a]	51	0.0	17.6	76.5	51.0	52.9	9.8	0.0	0.0	0.0	43.1	0.0
Poland*	24	12.5	8.3	29.2	25.0	16.7	12.5	12.5	25.0	41.7	8.3	37.5
Portugal	130	22.3	21.5	37.7	43.1	20.8	14.6	23.1	32.3	71.5	37.7	10.8
Slovakia	59	0.0	0.0	32.2	5.1	52.5	1.7	0.0	0.0	5.1	0.0	30.5

Country/ Administration	Included LTCFs	Antimicrobial committee	Training on appropriate prescribing	Written guidelines for appropriate antimicrobial use	Data on annual antimicrobial consumption	Reminder of the importance of samples	Local antimicrobial resistance profiles	Permission for prescribing restricted antimicrobials	Advice from a pharmacist	Therapeutic formulary	Feedback to GPs on antimicrobial consumption	None of these elements
	N	%	%	%	%	%	%	%	%	%	%	%
Spain	42	45.2	33.3	73.8	61.9	33.3	31.0	33.3	76.2	38.1	47.6	2.4
Sweden[a]	285	100.0	82.8	100.0	100.0	100.0	100.0	0.0	56.5	100.0	100.0	0.0
UK-Northern Ireland	70	1.4	2.9	28.6	5.7	68.6	4.3	2.9	24.3	21.4	1.4	17.1
UK-Scotland	52	1.9	1.9	28.8	0.0	21.2	11.5	7.7	19.2	21.2	5.8	44.2
UK-Wales	26	0.0	0.0	11.5	3.8	11.5	11.5	0.0	23.1	7.7	3.8	50.0
Total	**1 639**	**22.9**	**20.7**	**39.4**	**32.3**	**36.6**	**25.7**	**9.6**	**29.7**	**45.6**	**30.1**	**28.5**
North Macedonia*	4	25.0	25.0	25.0	25.0	0.0	25.0	0.0	75.0	25.0	50.0	0.0
Serbia*	6	0.0	16.7	33.3	33.3	16.7	0.0	0.0	0.0	33.3	16.7	16.7

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); GP: general practitioner; -: not available. Note that in a few countries, some antimicrobial stewardship responsibilities are held by professional bodies outside of the LTCFs, e.g. in Sweden, a therapeutic formulary is available to the GPs in all the counties.*

Figure 9. Percentage of the included LTCFs that reported having none of the 10 selected antimicrobial stewardship (AST) elements in place†, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample;*
† The ten elements are: antimicrobial (AM) committee, training on appropriate prescribing, written guidelines for appropriate AM use, data on annual AM consumption, reminder of the importance of samples, local AM resistance profiles, permission for prescribing restricted AM, advice from a pharmacist, therapeutic formulary, and feedback to GPs on AM consumption.

A restrictive list of antimicrobials for prescription was only available in 24.0% of the LTCFs (Table 14). None of the participating LTCFs in Germany, Luxembourg, Malta and Sweden had such a list, while all facilities in Slovakia and all but one of the included LTCFs in the Netherlands had a restrictive list. In Slovakia, the following antimicrobials were restricted in all LTCFs: carbapenems, third-generation cephalosporins, fluoroquinolones, vancomycin, glycopeptides, 'broad-spectrum antibiotics' (as per national definition) and intravenously administered antibiotics. No further details were provided for the Netherlands. Overall, the most commonly restricted antimicrobials were carbapenems (68.1%), vancomycin (61.9%), glycopeptides (52.3%) and intravenously administered antibiotics (52.3%).

Written therapeutic guidelines for RTIs, UTIs, and wound and soft tissue infections were available in 44.2%, 49.4%, and 48.7% of the participating LTCFs, respectively (Table 14). Figure 10 presents the proportion of LTCFs that had written therapeutic guidelines for all three of these (i.e. RTIs, UTIs and wound and soft tissue infections), by country/administration. Overall, 41.7% of all the LTCFs had all three written therapeutic guidelines available.

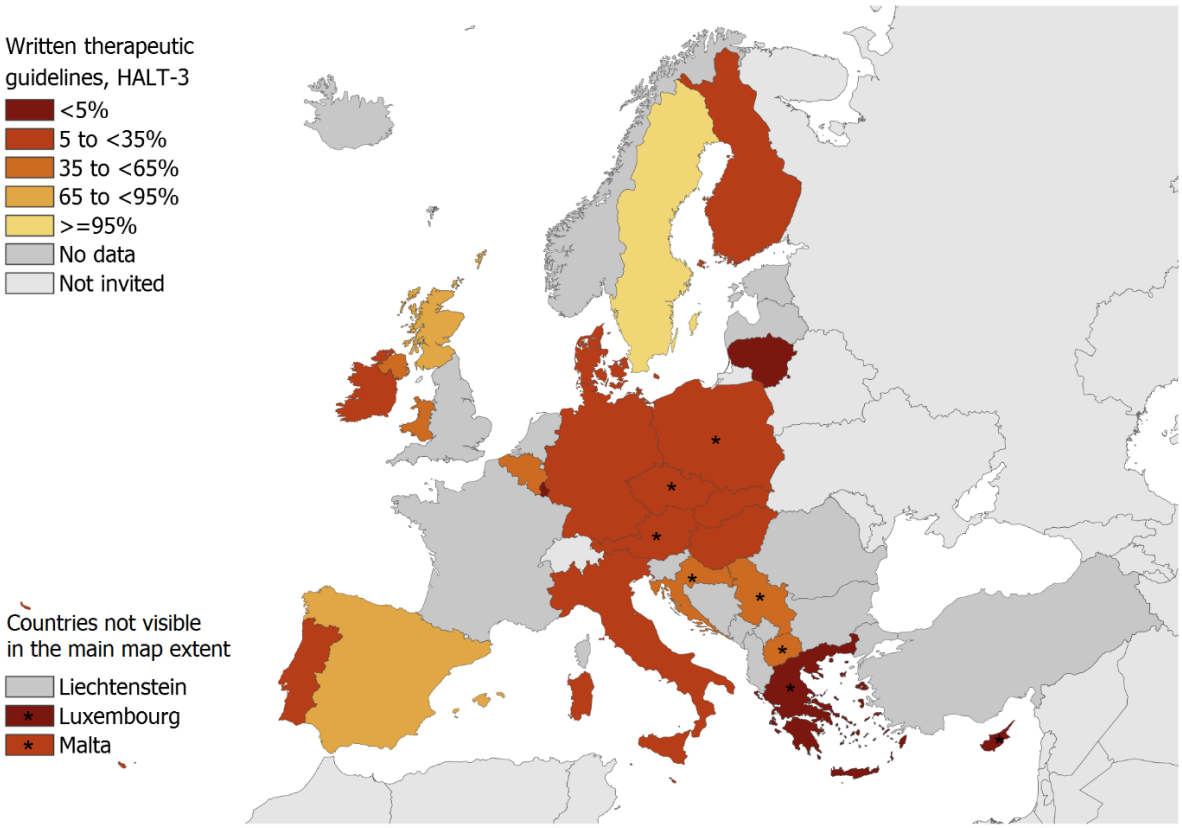
Table 14. Availability of a restrictive list of antimicrobials to be prescribed, written therapeutic guidelines and the presence of surveillance programmes in the included LTCFs, by country/administration, HALT-3, 2016–2017

Country/Administration	Restrictive list of antimicrobials		Written therapeutic guidelines				Surveillance programmes			
	Included LTCFs	Restrictive list available	Included LTCFs**	Respiratory tract infections (RTIs)	Urinary tract infections (UTIs)	Wound and soft tissue infections	Included LTCFs**	Healthcare-associated infections (HAIs)	Antimicrobial consumption	Antimicrobial-resistant microorganisms
	N	%	N	%	%	%	N	%	%	%
Austria*	12	16.7	12	66.7	66.7	8.3	12	16.7	41.7	91.7
Belgium	79	13.9	50	50.0	56.0	46.0	72	43.1	20.8	52.8
Croatia*	8	12.5	8	37.5	37.5	37.5	8	100.0	12.5	25.0
Cyprus*	11	9.1	11	9.1	18.2	27.3	11	0.0	0.0	0.0
Czechia*	9	11.1	9	22.2	22.2	33.3	9	44.4	11.1	22.2
Denmark	95	1.1	95	17.9	18.9	18.9	95	8.4	0.0	8.4
Finland	149	2.7	146	30.1	50.0	53.4	147	33.3	2.0	56.5
France[a]	-	-	-	-	-	-	-	-	-	-
Germany	82	0.0	41	14.6	17.1	19.5	76	13.2	6.6	30.3
Greece*	13	38.5	12	0.0	0.0	8.3	13	0.0	0.0	0.0
Hungary	75	13.3	75	26.7	24.0	32.0	75	16.0	5.3	12.0
Ireland	109	13.8	102	30.4	49.0	37.3	96	33.3	30.2	32.3
Italy	195	56.4	188	24.5	29.3	25.5	187	23.5	26.2	33.7
Lithuania	26	3.8	26	3.8	3.8	19.2	26	11.5	0.0	0.0
Luxembourg*	16	0.0	7	0.0	0.0	14.3	16	12.5	0.0	31.3
Malta*	11	0.0	11	27.3	27.3	27.3	10	10.0	0.0	60.0
Netherlands[a]	22	95.5	-	-	-	-	-	-	-	-
Norway[a]	-	-	-	-	-	-	58	98.3	22.4	15.5
Poland*	24	33.3	24	29.2	29.2	29.2	24	50.0	45.8	33.3
Portugal	132	77.3	130	33.1	36.9	34.6	127	57.5	48.0	43.3
Slovakia	59	100.0	59	16.9	22.0	30.5	59	6.8	0.0	0.0
Spain	46	54.3	42	69.0	69.0	69.0	42	69.0	54.8	71.4

Country/Administration	Restrictive list of antimicrobials		Written therapeutic guidelines				Surveillance programmes			
	Included LTCFs	Restrictive list available	Included LTCFs**	Respiratory tract infections (RTIs)	Urinary tract infections (UTIs)	Wound and soft tissue infections	Included LTCFs**	Healthcare-associated infections (HAIs)	Antimicrobial consumption	Antimicrobial-resistant microorganisms
	N	%	N	%	%	%	N	%	%	%
Sweden[a]	285	0.0	285	100.0	100.0	100.0	222	45.9	100.0	100.0
UK-Northern Ireland	70	2.9	70	44.3	44.3	47.1	68	29.4	29.4	22.1
UK-Scotland	51	9.8	21	81.0	95.2	85.7	50	58.0	16.0	16.0
UK-Wales	28	7.1	25	44.0	60.0	56.0	28	42.9	14.3	28.6
Total	**1 607**	**24.0**	**1449**	**44.2**	**49.4**	**48.7**	**1 531**	**35.5**	**31.0**	**41.5**
North Macedonia*	4	0.0	4	50.0	50.0	50.0	4	50.0	25.0	25.0
Serbia*	6	16.7	5	40.0	40.0	40.0	6	66.7	16.7	33.3

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); ** Excludes LTCFs with missing responses to questions on therapeutic guidelines/surveillance programmes; -: not available*

Figure 10. Percentage of the included LTCFs with written therapeutic guidelines for UTIs, RTIs and wound and soft tissue infections, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample.*

The surveillance of antimicrobial-resistant microorganisms was carried out as a standard activity, outside of this present survey, in 41.5% of LTCFs. This was more common than the surveillance of HAIs (35.5%) or antimicrobial consumption (31.0%) (Table 14). No country had all three surveillance activities in all of their participating LTCFs.

More than half of all LTCFs in Croatia, Norway, Poland, Portugal, Spain and UK-Scotland had surveillance of HAIs, while none of the LTCFs in Cyprus and Greece reported having this surveillance. In seven countries (Cyprus, Denmark, Greece, Lithuania, Luxembourg, Malta and Slovakia), no LTCF monitored antimicrobial use; and only Spain and Sweden had more than 50% of LTCFs with surveillance of antimicrobial use.

Austria, Belgium, Finland, Malta, Spain and Sweden reported surveillance of antimicrobial-resistant microorganisms in more than 50% of their LTCFs. In Sweden, all LTCFs monitored antimicrobial-resistant microorganisms, while no LTCF reported having this surveillance in Cyprus, Greece, Lithuania and Slovakia.

3.2.6 Healthcare-associated infections

Data imputation with the EU/EEA average was performed for the types of healthcare-associated infections (HAIs) for which data were not collected during the national surveys in France, the Netherlands and Norway (see Section 2, 'Methodology'). For France, 12 HAIs – all associated with the current LTCF – were added. For the Netherlands, 10 HAIs associated with the current LTCF and one associated with another healthcare facility were added. For Norway, nine HAIs associated with the current LTCF were added. In addition, for Norway, the aggregated numbers of UTIs and skin infections were distributed across the different types of HAI using the EU/EEA proportion. Substituted values as indicated, are presented in Tables 17 and 18.

Prevalence of HAIs

Overall, 3 780 (3.7%) of the 102 301 eligible residents had at least one HAI on the day of the survey. The median prevalence in the participating LTCFs was 2.1%, ranging from 0.9% in Hungary to 8.9% in Spain (Table 15). Of the 1 788 participating LTCFs, 683 (38.2%) reported having no resident with an active HAI on the day of the survey.

These 3 780 residents had at least 3 858 HAIs (these data were not available for 20/1 777 LTCFs, including nine LTCFs in Czechia and 11 LTCFs in Cyprus).

Table 15. Number and prevalence of LTCF residents with at least one HAI on the day of the PPS, by country/administration, HALT-3, 2016–2017

Country/Administration	N of LTCFs	N of eligible residents	N of residents with HAI (all HAI origins)	Prevalence (%) of residents with at least one HAI				N of HAIs (all HAI origins)
				Overall %	P25	Median	P75	
Austria*	12	2 065	105	5.1	1.6	2.7	8.1	107
Belgium	79	8 206	354	4.3	2.4	3.7	6.3	364
Croatia*	8	1 607	15	0.9	0.3	1.1	1.8	15
Cyprus*	11	312	15	4.8	0.0	4.8	7.7	-
Czechia*	9	-	-	-	-	-	-	-
Denmark	95	3 346	175	5.2	0.0	4.2	7.4	180
Finland	149	5 914	208	3.5	0.0	2.9	5.4	215
France[a]†	91	6 957	206	3.0	0.0	2.1	4.0	206
Germany	82	6 705	115	1.7	0.0	0.9	2.6	115
Greece*	13	812	51	6.3	2.7	6.0	11.6	52
Hungary	75	7 670	73	1.0	0.0	0.0	1.4	73
Ireland	109	5 613	276	4.9	1.7	4.0	7.7	285

Country/Administration	N of LTCFs	N of eligible residents	N of residents with HAI (all HAI origins)	Prevalence (%) of residents with at least one HAI				N of HAIs (all HAI origins)
				Overall %	P25	Median	P75	
Italy	196	11 417	442	3.9	0.0	2.9	6.3	456
Lithuania	26	3 438	32	0.9	0.0	0.0	1.7	32
Luxembourg*	16	1 616	30	1.9	0.3	1.5	2.8	30
Malta*	11	2 485	76	3.1	1.1	1.5	1.9	81
Netherlands[a]†	57	4 547	160	3.5	1.2	3.2	5.3	160
Norway[a]†	62	2 447	119	4.9	0.0	3.8	6.7	119
Poland*	24	2 281	90	3.9	0.0	2.6	5.4	92
Portugal	132	3 633	214	5.9	0.0	3.6	9.5	226
Slovakia	59	5 091	108	2.1	0.0	1.5	3.3	112
Spain	46	6 808	579	8.5	3.5	7.0	13.6	598
Sweden[a]	285	3 604	57	1.6	0.0	0.0	0.0	58
UK-Northern Ireland	70	2 614	97	3.7	0.0	3.5	5.9	98
UK-Scotland	52	2 147	125	5.8	0.0	5.0	10.0	126
UK-Wales	28	966	58	6.0	3.1	4.8	9.7	58
Total	**1 797**	**102 301**	**3 780**	**3.7**	**0.0**	**2.1**	**5.6**	**3 858**
North Macedonia*	4	294	10	3.4	1.6	4.1	5.1	10
Serbia*	6	1 168	37	3.2	2.3	3.1	3.7	41

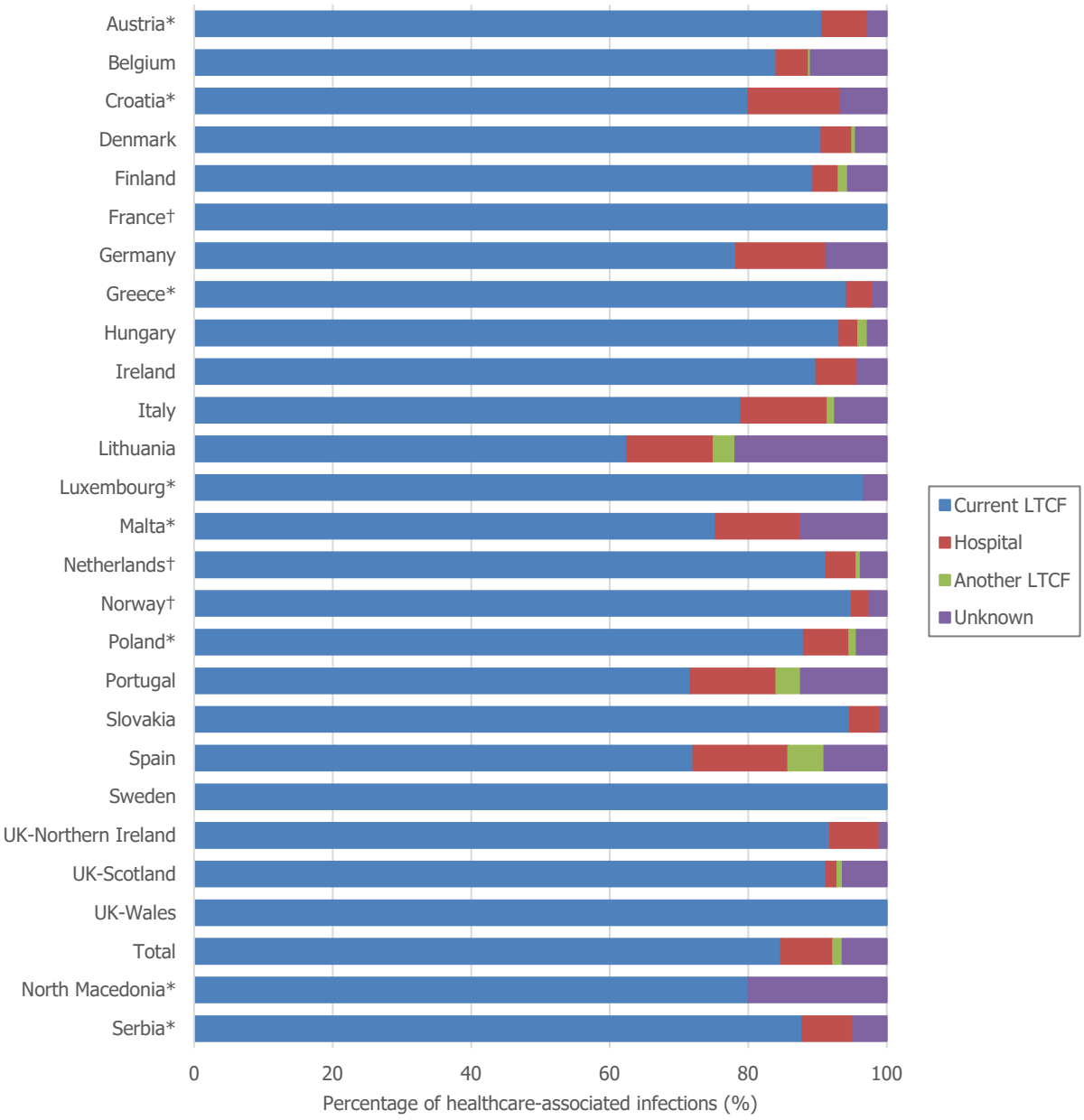
*HAI%: crude prevalence, i.e. number of eligible residents with at least one HAI / number of eligible residents × 100; * Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); † Data imputed for infections that are not collected in national surveys; -: not available.*

The majority of the reported HAIs (n=3 269/3 858; 84.7%) were associated with the current LTCF, while 7.5% and 1.4% were associated with a hospital or another LTCF, respectively. The origin was unknown for 6.4% of the HAIs.

All HAIs in the LTCFs in UK-Wales were associated with the current LTCF. In their national surveys, France and Sweden only collected data on HAIs associated with the current LTCF. In seven countries, more than 10% of all HAIs were reported as being associated with a hospital: Spain (13.7%), Croatia (13.3%), Germany (13.0%), Lithuania (12.5%), Italy (12.5%), Portugal (12.4%) and Malta (12.3%). The three countries with the highest proportion of HAIs associated with another LTCF were Spain (5.2%), Portugal (3.5%) and Italy (3.1%). The countries with the highest proportion of HAIs with an unknown origin were Lithuania (21.9%), Portugal (12.4%), Malta (12.3%) and Belgium (11.1%) (Figure 11).

When only considering HAIs that were associated with the current LTCF, the crude prevalence of residents with at least one HAI decreased from 3.7% to 3.1%. The median prevalence of these HAIs was 1.7%, overall (crude) prevalence varying from 0.6% in Lithuania to 7.1% in Greece (Table 16). Conversely, the number of LTCFs that reported no HAIs increased to 758 (42.2%).

Figure 11. Origin of reported HAIs, by country/administration, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample; † Data imputed for infections that are not collected in national surveys; No data available for Cyprus and Czechia.*

Table 16. Number and prevalence of LTCF residents with at least one HAI associated with the current LTCF on the day of the PPS, by country/administration, HALT-3, 2016–2017

Country/Administration	N of LTCFs	N of eligible residents	N of residents with HAI (own LTCF)	Prevalence (%) of residents with at least one HAI				N of HAIs (current LTCF)
				Overall %	P25	Median	P75	
Austria*	12	2 065	95	4.6	1.6	2.7	7.2	97
Belgium	79	8 206	299	3.6	1.7	3.1	5.3	306
Croatia*	8	1 607	12	0.7	0.2	0.8	1.6	12
Cyprus*	11	312	-	-	-	-	-	-
Czechia*	9	-	-	-	-	-	-	-
Denmark	95	3 346	160	4.8	0.0	3.8	7.1	163
Finland	149	5 914	187	3.2	0.0	2.3	4.8	192
France[a]†	91	6 957	206	3.0	0.0	2.1	4.0	206
Germany	82	6 705	90	1.3	0.0	0.0	1.9	90
Greece*	13	812	48	5.9	2.1	6.0	11.6	49
Hungary	75	7 670	68	0.9	0.0	0.0	1.2	68
Ireland	109	5 613	250	4.5	1.3	3.8	6.8	256
Italy	196	11 417	353	3.1	0.0	2.1	5.0	360
Lithuania	26	3 438	20	0.6	0.0	0.0	0.5	20
Luxembourg*	16	1 616	29	1.8	0.3	1.3	2.7	29
Malta*	11	2 485	57	2.3	0.0	1.0	1.9	61
Netherlands[a]†	57	4 547	146	3.2	1.1	2.4	5.0	146
Norway[a]†	62	2 447	113	4.6	0.0	3.7	6.7	113
Poland*	24	2 281	80	3.5	0.0	2.1	4.7	81
Portugal	132	3 633	158	4.3	0.0	0.0	6.9	162
Slovakia	59	5 091	102	2.0	0.0	1.3	3.3	106
Spain	46	6 808	424	6.2	3.4	5.8	7.5	431
Sweden[a]	285	3 604	57	1.6	0.0	0.0	0.0	58
UK-Northern Ireland	70	2 614	89	3.4	0.0	2.7	5.6	90
UK-Scotland	52	2 147	114	5.3	0.0	4.7	10.0	115
UK-Wales	28	966	58	6.0	3.1	4.8	9.7	58
Total	**1 797**	**102 301**	**3 215**	**3.1**	**0.0**	**1.7**	**5.0**	**3 269**
North Macedonia*	4	294	8	2.7	0.0	1.6	4.2	8
Serbia*	6	1 168	33	2.8	2.2	2.9	3.7	36

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); † Data imputed for infections that are not collected in national surveys; -: not available*

Types of HAI

The vast majority of the reported HAIs (n=3 858) were one of three infection types: respiratory tract infections (RTIs, 33.2%), urinary tract infections (UTIs, 32.0%) and skin infections (21.5%). The next most common infection type was eye, ear, nose and mouth infections (4.7%). The other types of HAI represented less than 10% of HAIs, and included gastrointestinal infections (2.9%), other infections (2.6%), surgical site infections (1.7%), unexplained fever (0.9%), and bloodstream infections (0.5%) (Table 17).

Figure 12 presents the distribution of HAIs by origin and type. The most frequently reported HAIs associated with the current LTCF (n=3 269) were RTIs (34.8%), UTIs (32.5%) and skin infections (21.2%). Similarly, HAIs associated with another LTCF (n=54) were primarily RTIs (38.9%), UTIs (24.1%) and skin infections (24.1%). HAIs associated with a hospital were mainly UTIs (30.1%), RTIs (20.1%), skin infections (17.0%), followed by surgical site infections (SSIs) (16.3%).

Figure 12. Distribution of HAIs in the included LTCFs, by origin and type, HALT-3, 2016–2017

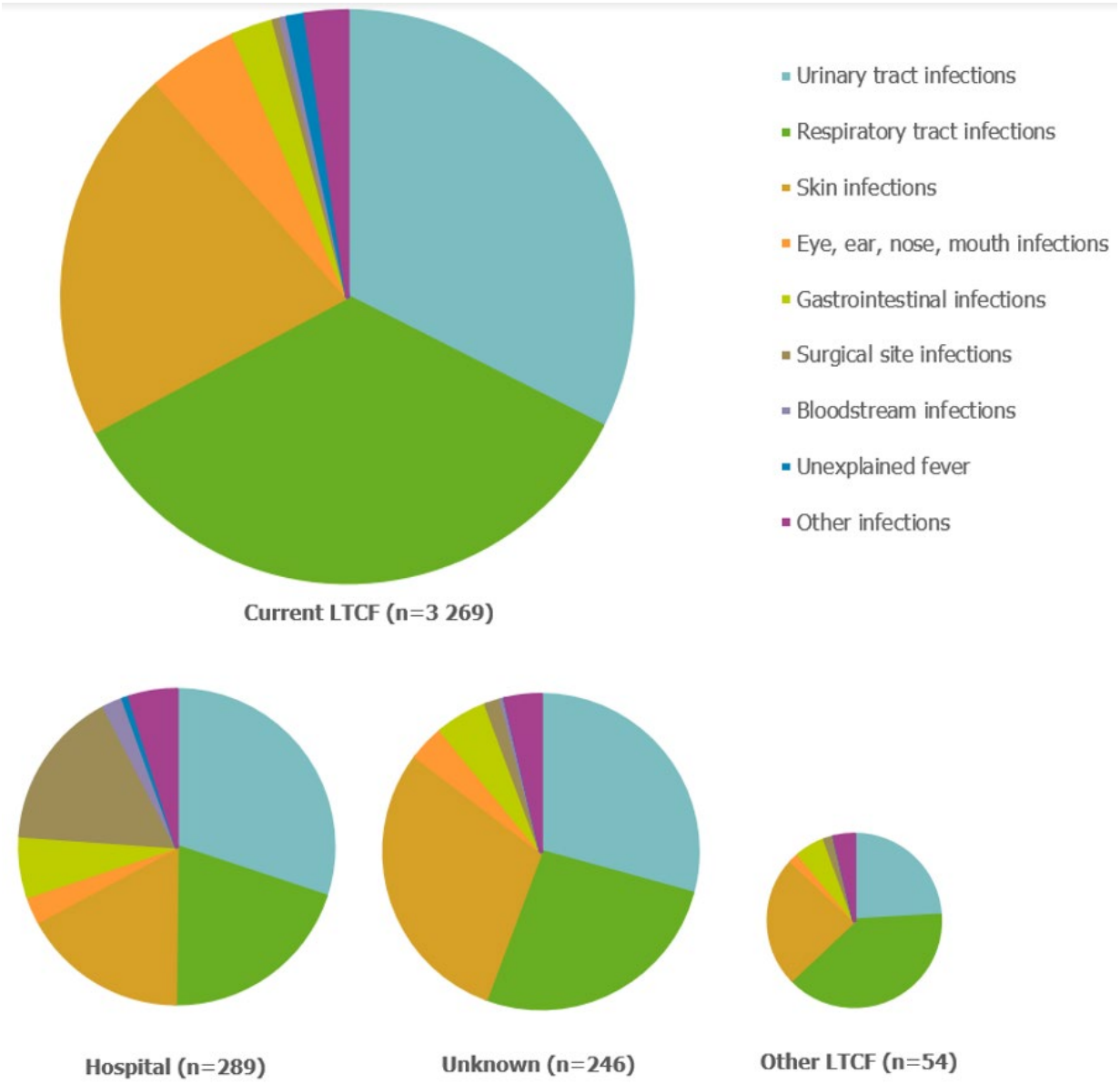


Table 17. Distribution of types of HAI (number and relative frequency) in the included LTCFs, by country/administration, HALT-3, 2016–2017

Types of HAI	EU/EEA		Austria*		Belgium		Croatia*		Denmark		Finland		France[a]†		Germany		Greece*		Hungary	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
All types of HAI	**3 858**	**100**	107	100	364	100	15	100	180	100	215	100	206	100	115	100	52	100	73	100
Urinary tract infections (UTIs)	**1 233**	**32.0**	20	18.7	100	27.5	8	53.3	63	35.0	71	33.0	89	43.2	36	31.3	13	25.0	20	27.4
Confirmed UTIs	**534**	**13.8**	10	9.3	64	17.6	4	26.7	22	12.2	40	18.6	54	26.2	11	9.6	4	7.7	4	5.5
Probable UTIs	**642**	**16.6**	9	8.4	35	9.6	3	20.0	40	22.2	31	14.4	35	17.0	22	19.1	8	15.4	16	21.9
Respiratory tract infections (RTIs)	**1 280**	**33.2**	28	26.2	155	42.6	5	33.3	26	14.4	40	18.6	65	31.6	23	20.0	27	51.9	23	31.5
Common cold/pharyngitis	**277**	**7.2**	7	6.5	58	15.9	0	0.0	6	3.3	8	3.7	9‡	4.4	17	14.8	1	1.9	15	20.5
'Flu'[b]	**13**	**0.3**	1	0.9	4	1.1	0	0.0	0	0.0	0	0.0	0‡	0.0	0	0.0	0	0.0	0	0.0
Pneumonia	**143**	**3.7**	12	11.2	5	1.4	1	6.7	5	2.8	9	4.2	3	1.5	1	0.9	6	11.5	1	1.4
Other lower RTIs	**847**	**22.0**	8	7.5	88	24.2	4	26.7	15	8.3	23	10.7	53	25.7	5	4.3	20	38.5	7	9.6
Skin infections	**828**	**21.5**	38	35.5	70	19.2	1	6.7	68	37.8	69	32.1	50	24.3	36	31.3	1	1.9	20	27.4
Cellulitis/soft tissue/wound infections	**667**	**17.3**	36	33.6	53	14.6	1	6.7	45	25.0	53	24.7	49	23.8	27	23.5	1	1.9	17	23.3
Herpes simplex or zoster infections	**24**	**0.6**	0	0.0	2	0.5	0	0.0	1	0.6	1	0.5	0	0.0	3	2.6	0	0.0	1	1.4
Fungal infections	**135**	**3.5**	2	1.9	15	4.1	0	0.0	22	12.2	15	7.0	1‡	0.5	6	5.2	0	0.0	1	1.4
Scabies	**2**	**0.1**	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.4
Eye, ear, nose and mouth infections	**183**	**4.7**	9	8.4	13	3.6	0	0.0	12	6.7	12	5.6	0	0.0	7	6.1	0	0.0	0	0.0
Conjunctivitis	**118**	**3.1**	2	1.9	8	2.2	0	0.0	8	4.4	9	4.2	0‡	0.0	6	5.2	0	0.0	0	0.0
Ear infections	**25**	**0.6**	4	3.7	0	0.0	0	0.0	0	0.0	1	0.5	0‡	0.0	1	0.9	0	0.0	0	0.0
Sinusitis	**5**	**0.1**	1	0.9	1	0.3	0	0.0	0	0.0	1	0.5	0‡	0.0	0	0.0	0	0.0	0	0.0
Oral candidiasis	**35**	**0.9**	2	1.9	4	1.1	0	0.0	4	2.2	1	0.5	0‡	0.0	0	0.0	0	0.0	0	0.0
Gastrointestinal infections	**112**	**2.9**	3	2.8	13	3.6	0	0.0	9	5.0	5	2.3	1	0.5	8	7.0	4	7.7	6	8.2
Gastroenteritis	**75**	**1.9**	0	0.0	12	3.3	0	0.0	6	3.3	4	1.9	1‡	0.5	6	5.2	4	7.7	4	5.5

Types of HAI	EU/EEA		Austria*		Belgium		Croatia*		Denmark		Finland		France[a]†		Germany		Greece*		Hungary	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Clostridioides difficile infection	**37**	**1.0**	3	2.8	1	0.3	0	0.0	3	1.7	1	0.5	0	0.0	2	1.7	0	0.0	2	2.7
Surgical site infections (SSIs)	**66**	**1.7**	5	4.7	4	1.1	1	6.7	1	0.6	5	2.3	0	0.0	2	1.7	0	0.0	1	1.4
Superficial SSI	**32**	**0.8**	2	1.9	1	0.3	1	6.7	1	0.6	2	0.9	0	0.0	2	1.7	0	0.0	0	0.0
Deep SSI	**17**	**0.4**	1	0.9	1	0.3	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	1	1.4
Organ/space SSI	**17**	**0.4**	2	1.9	2	0.5	0	0.0	0	0.0	2	0.9	0	0.0	0	0.0	0	0.0	0	0.0
Bloodstream infections	**19**	**0.5**	2	1.9	0	0.0	0	0.0	0	0.0	1	0.5	0‡	0.0	0	0.0	0	0.0	0	0.0
Unexplained fever	**35**	**0.9**	2	1.9	4	1.1	0	0.0	0	0.0	7	3.3	0‡	0.0	0	0.0	3	5.8	1	1.4
Other infections	**102**	**2.6**	0	0.0	5	1.4	0	0.0	1	0.6	5	2.3	1‡	0.5	3	2.6	4	7.7	2	2.7

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); [b] In HALT-3, 'flu' was defined as fever: a) single >37.8 °C oral/tympanic membrane OR b) repeated >37.2 °C oral OR >37.5 °C rectal OR c) >1.1 °C above baseline from any site – and at least three of the following symptoms: chills, new headache or eye pain, myalgia or body aches, malaise or loss of appetite, sore throat, or new/increased dry cough; † Data imputed for infections that are not collected in national surveys; ‡ Substituted values to replace missing infection types; No data for Cyprus and Czechia.*

Table 17. Distribution of types of HAI (number and relative frequency) in the included LTCFs, by country/administration, HALT-3, 2016–2017 (continued)

Types of HAI	Ireland		Italy		Lithuania		Luxembourg*		Malta*		Netherlands[a]†		Norway[a]†		Poland*		Portugal		Slovakia	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
All types of HAI	285	100	456	100	32	100	30	100	81	100	160	100	119	100	92	100	226	100	112	100
Urinary tract infections (UTIs)	84	29.5	126	27.6	8	25.0	10	33.3	23	28.4	61	38.1	69	58.0	27	29.3	83	36.7	19	17.0
Confirmed UTIs	26	9.1	58	12.7	2	6.3	2	6.7	9	11.1	12	7.5	23	19.3	7	7.6	59	26.1	5	4.5
Probable UTIs	55	19.3	57	12.5	6	18.8	8	26.7	14	17.3	43	26.9	46	38.7	20	21.7	22	9.7	12	10.7
Respiratory tract infections (RTIs)	99	34.7	178	39.0	5	15.6	10	33.3	31	38.3	33	20.6	36	30.3	21	22.8	57	25.2	66	58.9
Common cold/pharyngitis	6	2.1	17	3.7	2	6.3	0	0.0	9	11.1	10‡	6.3	8‡	6.7	3	3.3	8	3.5	52	46.4
'Flu'[b]	0	0.0	3	0.7	0	0.0	1	3.3	0	0.0	0‡	0.0	0‡	0.0	0	0.0	1	0.4	0	0.0
Pneumonia	10	3.5	23	5.0	1	3.1	0	0.0	3	3.7	0	0.0	0	0.0	5	5.4	17	7.5	3	2.7
Other lower RTIs	83	29.1	135	29.6	2	6.3	9	30.0	19	23.5	23	14.4	28	23.5	13	14.1	31	13.7	11	9.8
Skin infections	69	24.2	67	14.7	17	53.1	6	20.0	14	17.3	60	37.5	10	8.4	26	28.3	44	19.5	15	13.4
Cellulitis/soft tissue/wound infections	59	20.7	62	13.6	13	40.6	5	16.7	14	17.3	23	14.4	10	8.4	20	21.7	34	15.0	11	9.8
Herpes simplex or zoster infections	2	0.7	3	0.7	0	0.0	0	0.0	0	0.0	2	1.3	0	0.0	0	0.0	3	1.3	1	0.9
Fungal infections	8	2.8	2	0.4	4	12.5	1	3.3	0	0.0	35	21.9	0	0.0	6	6.5	7	3.1	2	1.8
Scabies	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0‡	0.0	0	0.0	0	0.0	0	0.0	1	0.9
Eye, ear, nose and mouth infections	15	5.3	18	3.9	1	3.1	1	3.3	8	9.9	3	1.9	1	0.8	8	8.7	20	8.8	3	2.7
Conjunctivitis	9	3.2	13	2.9	0	0.0	0	0.0	7	8.6	3	1.9	1‡	0.8	5	5.4	12	5.3	1	0.9
Ear infections	1	0.4	2	0.4	0	0.0	1	3.3	1	1.2	0‡	0.0	0‡	0.0	3	3.3	6	2.7	1	0.9
Sinusitis	0	0.0	0	0.0	1	3.1	0	0.0	0	0.0	0‡	0.0	0‡	0.0	0	0.0	0	0.0	1	0.9
Oral candidiasis	5	1.8	3	0.7	0	0.0	0	0.0	0	0.0	0‡	0.0	0‡	0.0	0	0.0	2	0.9	0	0.0
Gastrointestinal infections	4	1.4	24	5.3	0	0.0	2	6.7	2	2.5	0	0.0	0	0.0	6	6.5	2	0.9	3	2.7
Gastroenteritis	2	0.7	12	2.6	0	0.0	2	6.7	1	1.2	0	0.0	0‡	0.0	4	4.3	2	0.9	3	2.7

Types of HAI	Ireland		Italy		Lithuania		Luxembourg*		Malta*		Netherlands[a]†		Norway[a]†		Poland*		Portugal		Slovakia	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Clostridioides difficile infection	2	0.7	12	2.6	0	0.0	0	0.0	1	1.2	0	0.0	0‡	0.0	2	2.2	0	0.0	0	0.0
Surgical site infections (SSIs)	2	0.7	11	2.4	0	0.0	0	0.0	2	2.5	0	0.0	3	2.5	2	2.2	5	2.2	0	0.0
Superficial SSI	1	0.4	5	1.1	0	0.0	0	0.0	2	2.5	0‡	0.0	1	0.8	2	2.2	2	0.9	0	0.0
Deep SSI	1	0.4	2	0.4	0	0.0	0	0.0	0	0.0	0‡	0.0	2	1.7	0	0.0	3	1.3	0	0.0
Organ/space SSI	0	0.0	4	0.9	0	0.0	0	0.0	0	0.0	0‡	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Bloodstream infections	0	0.0	9	2.0	0	0.0	0	0.0	0	0.0	2	1.3	0‡	0.0	1	1.1	0	0.0	0	0.0
Unexplained fever	1	0.4	13	2.9	0	0.0	1	3.3	0	0.0	0‡	0.0	0‡	0.0	0	0.0	1	0.4	0	0.0
Other infections	11	3.9	10	2.2	1	3.1	0	0.0	1	1.2	1‡	0.6	0‡	0.0	1	1.1	14	6.2	6	5.4

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); [b] In HALT-3, 'flu' was defined as fever: a) single >37.8 °C oral/tympanic membrane OR b) repeated >37.2 °C oral OR >37.5 °C rectal OR c) >1.1 °C above baseline from any site – and at least three of the following symptoms: chills, new headache or eye pain, myalgia or body aches, malaise or loss of appetite, sore throat, or new/increased dry cough; † Data imputed for infections that are not collected in national surveys; ‡ Substituted values to replace missing infection types; No data for Cyprus and Czechia.*

Table 17. Distribution of types of HAI (number and relative frequency) in the included LTCFs, by country/administration, HALT-3, 2016–2017 (continued)

Types of HAI	Spain		Sweden[a]		UK-Northern Ireland		UK-Scotland		UK-Wales		North Macedonia*		Serbia*	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
All types of HAI	598	100	58	100	98	100	126	100	58	100	10	100	41	100
Urinary tract infections (UTIs)	180	30.1	14	24.1	45	45.9	39	31.0	25	43.1	7	70.0	18	43.9
Confirmed UTIs	79	13.2	4	6.9	2	2.0	20	15.9	13	22.4	2	20.0	10	24.4
Probable UTIs	78	13.0	10	17.2	41	41.8	19	15.1	12	20.7	5	50.0	8	19.5
Respiratory tract infections (RTIs)	236	39.5	13	22.4	29	29.6	48	38.1	26	44.8	3	30.0	13	31.7
Common cold/pharyngitis	23	3.8	9	15.5	2	2.0	6	4.8	1	1.7	0	0.0	4	9.8
'Flu'[b]	1	0.2	0	0.0	0	0.0	2	1.6	0	0.0	0	0.0	0	0.0
Pneumonia	36	6.0	0	0.0	1	1.0	1	0.8	0	0.0	0	0.0	5	12.2
Other lower RTIs	176	29.4	4	6.9	26	26.5	39	31.0	25	43.1	3	30.0	4	9.8
Skin infections	70	11.7	23	39.7	21	21.4	29	23.0	4	6.9	0	0.0	5	12.2
Cellulitis/soft tissue/wound infections	64	10.7	21	36.2	20	20.4	25	19.8	4	6.9	0	0.0	4	9.8
Herpes simplex or zoster infections	2	0.3	2	3.4	1	1.0	0	0.0	0	0.0	0	0.0	1	2.4
Fungal infections	4	0.7	0	0.0	0	0.0	4	3.2	0	0.0	0	0.0	0	0.0
Scabies	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Eye, ear, nose and mouth infections	35	5.9	7	12.1	2	2.0	8	6.3	0	0.0	0	0.0	2	4.9
Conjunctivitis	21	3.5	6	10.3	1	1.0	6	4.8	0	0.0	0	0.0	0	0.0
Ear infections	4	0.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	4.9
Sinusitis	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Oral candidiasis	10	1.7	1	1.7	1	1.0	2	1.6	0	0.0	0	0.0	0	0.0
Gastrointestinal infections	19	3.2	1	1.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

Types of HAI	Spain		Sweden[a]		UK-Northern Ireland		UK-Scotland		UK-Wales		North Macedonia*		Serbia*	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Gastroenteritis	12	2.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Clostridioides difficile infection	7	1.2	1	1.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Surgical site infections (SSIs)	20	3.3	0	0.0	1	1.0	1	0.8	0	0.0	0	0.0	2	4.9
Superficial SSI	8	1.3	0	0.0	1	1.0	1	0.8	0	0.0	0	0.0	1	2.4
Deep SSI	5	0.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	2.4
Organ/space SSI	7	1.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Bloodstream infections	4	0.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Unexplained fever	2	0.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	2.4
Other infections	32	5.4	0	0.0	0	0.0	1	0.8	3	5.2	0	0.0	0	0.0

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); [b] In HALT-3, 'flu' was defined as fever: a) single >37.8 °C oral/tympanic membrane OR b) repeated >37.2 °C oral OR >37.5 °C rectal OR c) >1.1 °C above baseline from any site – and at least three of the following symptoms: chills, new headache or eye pain, myalgia or body aches, malaise or loss of appetite, sore throat, or new/increased dry cough; No data for Cyprus and Czechia.*

In total, 212 (41.5%) of the 511 HAIs that were not associated with the current facility were reported to be 'imported infections', i.e. in residents who were recently transferred from another healthcare facility, with ongoing treatment for an infection on the day of the survey, but with insufficient documentation of previous signs/symptoms to apply the case definition algorithm. These 212 HAIs represented 5.5% of all reported HAIs. 'Imported infections' were reported in 18 countries, while six countries reported none. The majority of 'imported infections' were reported by Spain (36.3%), Italy (17.0%) and Portugal (11.8%). The majority (63.7%) of these 'imported infections' originated from a hospital, while 9.9% were from another LTCF, and the origin of the HAI was unknown for 26.4%. 'Imported infections' were mainly RTIs (31.1%), UTIs (26.9%), skin infections (20.3%) and SSIs (11.8%).

The three most common types of HAI accounted for more than 80% of all HAIs associated with the current LTCF (RTIs: 34.8%; UTIs: 32.8%; skin infections: 21.2%). These three types of HAI were the most common in all countries except Greece, for which the three most common types were RTIs (53.1%), UTIs (24.5%) and gastrointestinal infections (8.2%). Skin infections, rather than RTIs, were the most common type of HAI reported by Austria, Denmark, Germany, Lithuania and Sweden (Figure 13).

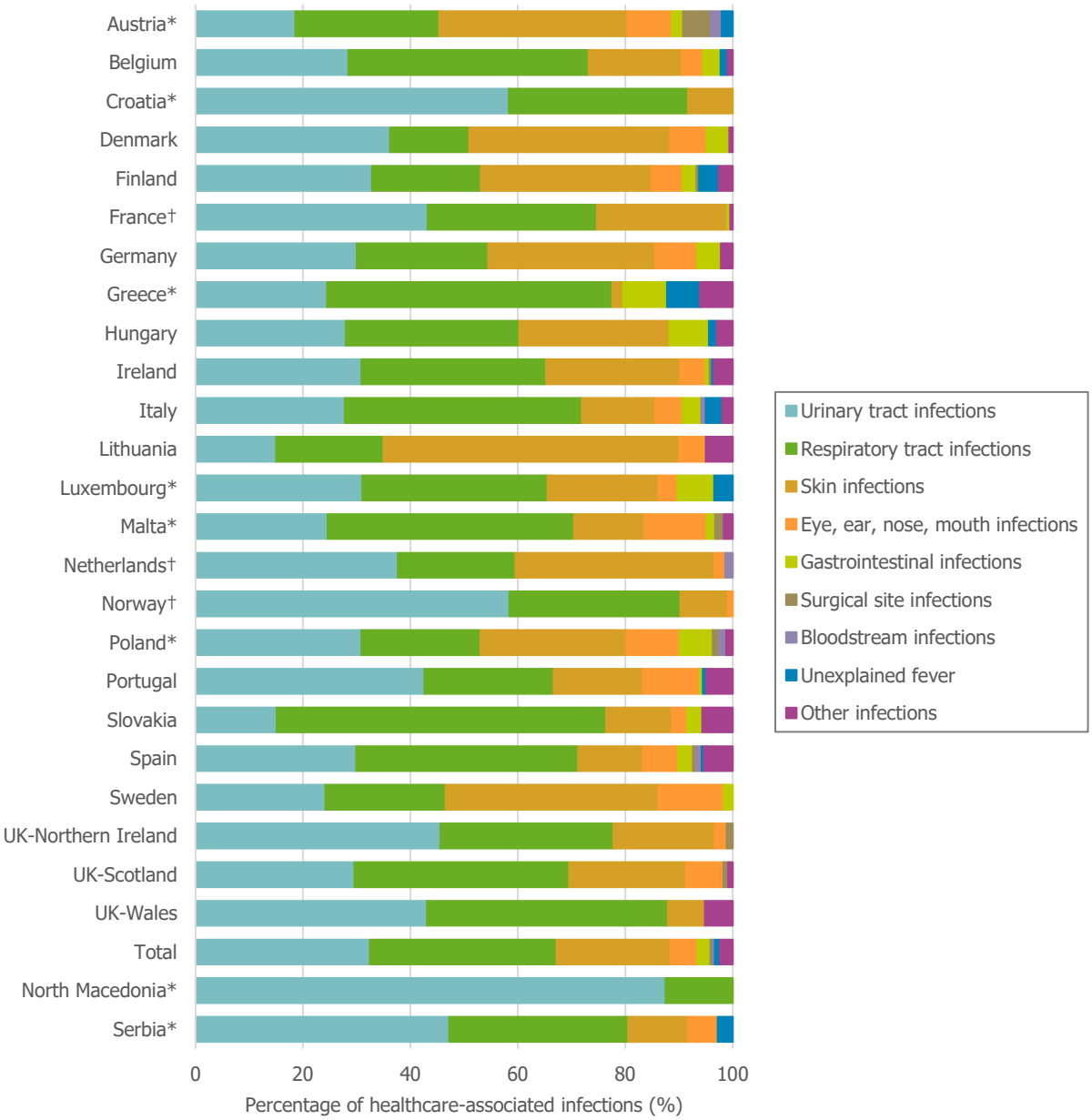
The majority of RTIs associated with the current LTCF were lower RTIs other than pneumonia (68.1%; Table 18). Only 7.6% of these RTIs were pneumonia cases, perhaps because the infection definition required a chest X-ray that was positive for pneumonia or showed evidence of a new infiltrate. Common cold/pharyngitis accounted for 23.2% of the RTIs, while only a few cases of flu (n=12; 1.1%) were reported.

More than half (56.1%) of the UTIs associated with the current LTCF were 'probable' UTIs, i.e. cases where the resident had enough signs/symptoms to suspect a UTI, but without microbiological confirmation (i.e. a urine culture was not done, or the result was negative or not available at the time of the survey); 43.9% of the UTIs associated with the current LTCF were reported as 'confirmed', i.e. signs/symptoms were present and there was a positive microbiological urine culture.

The majority of skin infections (21.2% of all HAIs associated with the current LTCF) were cellulitis/soft tissue/wound infections (80.8%) and fungal infections (16.2%). Herpes simplex or zoster infections and scabies were rarely reported (0.6% and 0.1% of all HAIs associated with the current LTCF), respectively.

The fourth most common type of HAI were eye, ear, nose and mouth infections (5.0%) and consisted of conjunctivitis (66.1%), oral candidiasis (18.2%), ear infections (13.3%) and sinusitis (2.4%).

Figure 13. Distribution of types of HAI associated with the current LTCF, by country/administration, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample; † Data imputed for infections that are not collected in national surveys; No data for Cyprus and Czechia.*

Table 18. Distribution of types of HAI associated with the current LTCF (number and relative frequency) in the included LTCFs, by country/administration, HALT-3, 2016–2017

Types of HAI	EU/EEA		Austria*		Belgium		Croatia*		Denmark		Finland		France[a]†		Germany		Greece*		Hungary	
	n	%	n	%	n	%	N	%	n	%	n	%	n	%	n	%	n	%	n	%
All types of HAI	**3 269**	**100**	97	100	306	100	12	100	163	100	192	100	206	100	90	100	49	100	68	100
Urinary tract infections (UTIs)	**1 061**	**32.5**	18	18.6	87	28.4	7	58.3	59	36.2	63	32.8	89	43.2	27	30.0	12	24.5	19	27.9
Confirmed UTIs	**466**	**14.3**	9	9.3	57	18.6	4	33.3	21	12.9	35	18.2	54	26.2	7	7.8	4	8.2	4	5.9
Probable UTIs	**595**	**18.2**	9	9.3	30	9.8	3	25.0	38	23.3	28	14.6	35	17.0	20	22.2	8	16.3	15	22.1
Respiratory tract infections (RTIs)	**1 136**	**34.8**	26	26.8	137	44.8	4	33.3	24	14.7	39	20.3	65	31.6	22	24.4	26	53.1	22	32.4
Common cold/pharyngitis	**264**	**8.1**	7	7.2	52	17.0	0	0.0	6	3.7	8	4.2	9‡	4.4	17	18.9	1	2.0	14	20.6
'Flu'[b]	**12**	**0.4**	1	1.0	4	1.3	0	0.0	0	0.0	0	0.0	0‡	0.0	0	0.0	0	0.0	0	0.0
Pneumonia	**86**	**2.6**	11	11.3	2	0.7	1	8.3	4	2.5	8	4.2	3	1.5	1	1.1	5	10.2	1	1.5
Other lower RTIs	**774**	**23.7**	7	7.2	79	25.8	3	25.0	14	8.6	23	12.0	53	25.7	4	4.4	20	40.8	7	10.3
Skin infections	**693**	**21.2**	34	35.1	53	17.3	1	8.3	61	37.4	61	31.8	50	24.3	28	31.1	1	2.0	19	27.9
Cellulitis/soft tissue/wound infections	**560**	**17.1**	32	33.0	43	14.1	1	8.3	42	25.8	46	24.0	49	23.8	20	22.2	1	2.0	17	25.0
Herpes simplex or zoster infections	**19**	**0.6**	0	0.0	1	0.3	0	0.0	1	0.6	1	0.5	0	0.0	2	2.2	0	0.0	0	0.0
Fungal infections	**112**	**3.4**	2	2.1	9	2.9	0	0.0	18	11.0	14	7.3	1‡	0.5	6	6.7	0	0.0	1	1.5
Scabies	**2**	**0.1**	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.5
Eye, ear, nose and mouth infections	**165**	**5.0**	8	8.2	12	3.9	0	0.0	11	6.7	11	5.7	0	0.0	7	7.8	0	0.0	0	0.0
Conjunctivitis	**109**	**3.3**	2	2.1	8	2.6	0	0.0	8	4.9	9	4.7	0‡	0.0	6	6.7	0	0.0	0	0.0
Ear infections	**22**	**0.7**	4	4.1	0	0.0	0	0.0	0	0.0	1	0.5	0‡	0.0	1	1.1	0	0.0	0	0.0
Sinusitis	**4**	**0.1**	1	1.0	0	0.0	0	0.0	0	0.0	1	0.5	0‡	0.0	0	0.0	0	0.0	0	0.0
Oral candidiasis	**30**	**0.9**	1	1.0	4	1.3	0	0.0	3	1.8	0	0.0	0‡	0.0	0	0.0	0	0.0	0	0.0
Gastrointestinal infections	**78**	**2.4**	2	2.1	10	3.3	0	0.0	7	4.3	5	2.6	1	0.5	4	4.4	4	8.2	5	7.4

Types of HAI	EU/EEA		Austria*		Belgium		Croatia*		Denmark		Finland		France[a]†		Germany		Greece*		Hungary	
	n	%	n	%	n	%	N	%	n	%	n	%	n	%	n	%	n	%	n	%
Gastroenteritis	**58**	**1.8**	0	0.0	10	3.3	0	0.0	5	3.1	4	2.1	1‡	0.5	4	4.4	4	8.2	4	5.9
Clostridioides difficile infection	**20**	**0.6**	2	2.1	0	0.0	0	0.0	2	1.2	1	0.5	0	0.0	0	0.0	0	0.0	1	1.5
Surgical site infections (SSIs)	**14**	**0.4**	5	5.2	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0
Superficial SSI	**8**	**0.2**	2	2.1	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0
Deep SSI	**3**	**0.1**	1	1.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Organ/space SSI	**3**	**0.1**	2	2.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Bloodstream infections	**12**	**0.4**	2	2.1	0	0.0	0	0.0	0	0.0	0	0.0	0‡	0.0	0	0.0	0	0.0	0	0.0
Unexplained fever	**33**	**1.0**	2	2.1	4	1.3	0	0.0	0	0.0	7	3.6	0‡	0.0	0	0.0	3	6.1	1	1.5
Other infections	**77**	**2.4**	0	0.0	3	1.0	0	0.0	1	0.6	5	2.6	1‡	0.5	2	2.2	3	6.1	2	2.9

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); [b] In HALT-3, 'flu' was defined as fever: a) single >37.8 °C oral/tympanic membrane OR b) repeated >37.2 °C oral OR >37.5 °C rectal OR c) >1.1 °C above baseline from any site – and at least three of the following symptoms: chills, new headache or eye pain, myalgia or body aches, malaise or loss of appetite, sore throat, or new/increased dry cough; † Data imputed for infections that are not collected in national surveys; ‡ Substituted values to replace missing infection types; No data for Cyprus and Czechia.*

Table 18. Distribution of types of HAI associated with the current LTCF (number and relative frequency) in the included LTCFs, by country/administration, HALT-3, 2016–2017 (continued)

Types of HAI	Ireland		Italy		Lithuania		Luxembourg*		Malta*		Netherlands[a]†		Norway[a]†		Poland*		Portugal		Slovakia	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
All types of HAI	256	100	360	100	20	100	29	100	61	100	146	100	113	100	81	100	162	100	106	100
Urinary tract infections (UTIs)	79	30.9	100	27.8	3	15.0	9	31.0	15	24.6	55	37.7	66	58.4	25	30.9	69	42.6	16	15.1
Confirmed UTIs	25	9.8	47	13.1	0	0.0	2	6.9	3	4.9	12	8.2	21	18.6	6	7.4	51	31.5	5	4.7
Probable UTIs	54	21.1	53	14.7	3	15.0	7	24.1	12	19.7	43	29.5	45	39.8	19	23.5	18	11.1	11	10.4
Respiratory tract infections (RTIs)	88	34.4	159	44.2	4	20.0	10	34.5	28	45.9	32	21.9	36	31.9	18	22.2	39	24.1	65	61.3
Common cold/pharyngitis	5	2.0	16	4.4	2	10.0	0	0.0	9	14.8	10‡	6.8	8‡	7.1	3	3.7	8	4.9	52	49.1
'Flu'[b]	0	0.0	3	0.8	0	0.0	1	3.4	0	0.0	0‡	0.0	0‡	0.0	0	0.0	1	0.6	0	0.0
Pneumonia	5	2.0	18	5.0	0	0.0	0	0.0	2	3.3	0	0.0	0	0.0	2	2.5	5	3.1	2	1.9
Other lower RTIs	78	30.5	122	33.9	2	10.0	9	31.0	17	27.9	22	15.1	28	24.8	13	16.0	25	15.4	11	10.4
Skin infections	64	25.0	49	13.6	11	55.0	6	20.7	8	13.1	54	37.0	10	8.8	22	27.2	27	16.7	13	12.3
Cellulitis/soft tissue/wound infections	54	21.1	45	12.5	11	55.0	5	17.2	8	13.1	19	13.0	10	8.8	18	22.2	20	12.3	10	9.4
Herpes simplex or zoster infections	2	0.8	2	0.6	0	0.0	0	0.0	0	0.0	2	1.4	0	0.0	0	0.0	3	1.9	1	0.9
Fungal infections	8	3.1	2	0.6	0	0.0	1	3.4	0	0.0	33	22.6	0	0.0	4	4.9	4	2.5	1	0.9
Scabies	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0‡	0.0	0	0.0	0	0.0	0	0.0	1	0.9
Eye, ear, nose and mouth infections	12	4.7	18	5.0	1	5.0	1	3.4	7	11.5	3	2.1	1	0.9	8	9.9	17	10.5	3	2.8
Conjunctivitis	6	2.3	13	3.6	0	0.0	0	0.0	6	9.8	3	2.1	1‡	0.9	5	6.2	11	6.8	1	0.9
Ear infections	1	0.4	2	0.6	0	0.0	1	3.4	1	1.6	0‡	0.0	0‡	0.0	3	3.7	4	2.5	1	0.9
Sinusitis	0	0.0	0	0.0	1	5.0	0	0.0	0	0.0	0‡	0.0	0‡	0.0	0	0.0	0	0.0	1	0.9
Oral candidiasis	5	2.0	3	0.8	0	0.0	0	0.0	0	0.0	0‡	0.0	0‡	0.0	0	0.0	2	1.2	0	0.0
Gastrointestinal infections	2	0.8	13	3.6	0	0.0	2	6.9	1	1.6	0	0.0	0	0.0	5	6.2	1	0.6	3	2.8

Types of HAI	Ireland		Italy		Lithuania		Luxembourg*		Malta*		Netherlands[a]†		Norway[a]†		Poland*		Portugal		Slovakia	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Gastroenteritis	1	0.4	6	1.7	0	0.0	2	6.9	1	1.6	0	0.0	0‡	0.0	4	4.9	1	0.6	3	2.8
Clostridioides difficile infection	1	0.4	7	1.9	0	0.0	0	0.0	0	0.0	0	0.0	0‡	0.0	1	1.2	0	0.0	0	0.0
Surgical site infections (SSIs)	1	0.4	0	0.0	0	0.0	0	0.0	1	1.6	0	0.0	0	0.0	1	1.2	0	0.0	0	0.0
Superficial SSI	0	0.0	0	0.0	0	0.0	0	0.0	1	1.6	0	0.0	0	0.0	1	1.2	0	0.0	0	0.0
Deep SSI	1	0.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Organ/space SSI	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Bloodstream infections	0	0.0	3	0.8	0	0.0	0	0.0	0	0.0	2	1.4	0‡	0.0	1	1.2	0	0.0	0	0.0
Unexplained fever	1	0.4	11	3.1	0	0.0	1	3.4	0	0.0	0‡	0.0	0‡	0.0	0	0.0	1	0.6	0	0.0
Other infections	9	3.5	7	1.9	1	5.0	0	0.0	1	1.6	0‡	0.0	0‡	0.0	1	1.2	8	4.9	6	5.7

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); [b] In HALT-3, 'flu' was defined as fever: a) single >37.8 °C oral/tympanic membrane OR b) repeated >37.2 °C oral OR >37.5 °C rectal OR c) >1.1 °C above baseline from any site – and at least three of the following symptoms: chills, new headache or eye pain, myalgia or body aches, malaise or loss of appetite, sore throat, or new/increased dry cough; † Data imputed for infections that are not collected in national surveys; ‡ Substituted values to replace missing infection types; No data for Cyprus and Czechia.*

Table 18. Distribution of types of HAI associated with the current LTCF (number and relative frequency) in the included LTCFs, by country/administration, HALT-3, 2016–2017 (continued)

Types of HAI	Spain		Sweden[a]		UK- Northern Ireland		UK- Scotland		UK- Wales		North Macedonia*		Serbia*	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
All types of HAI	431	100	58	100	90	100	115	100	58	100	8	100	36	100
Urinary tract infections (UTIs)	129	29.9	14	24.1	41	45.6	34	29.6	25	43.1	7	87.5	17	47.2
Confirmed UTIs	63	14.6	4	6.9	2	2.2	17	14.8	13	22.4	2	25.0	9	25.0
Probable UTIs	66	15.3	10	17.2	39	43.3	17	14.8	12	20.7	5	62.5	8	22.2
Respiratory tract infections (RTIs)	178	41.3	13	22.4	29	32.2	46	40.0	26	44.8	1	12.5	12	33.3
Common cold/pharyngitis	19	4.4	9	15.5	2	2.2	6	5.2	1	1.7	0	0.0	4	11.1
'Flu'[b]	1	0.2	0	0.0	0	0.0	1	0.9	0	0.0	0	0.0	0	0.0
Pneumonia	14	3.2	0	0.0	1	1.1	1	0.9	0	0.0	0	0.0	4	11.1
Other lower RTIs	144	33.4	4	6.9	26	28.9	38	33.0	25	43.1	1	12.5	4	11.1
Skin infections	52	12.1	23	39.7	17	18.9	25	21.7	4	6.9	0	0.0	4	11.1
Cellulitis/soft tissue/wound infections	46	10.7	21	36.2	17	18.9	21	18.3	4	6.9	0	0.0	3	8.3
Herpes simplex or zoster infections	2	0.5	2	3.4	0	0.0	0	0.0	0	0.0	0	0.0	1	2.8
Fungal infections	4	0.9	0	0.0	0	0.0	4	3.5	0	0.0	0	0.0	0	0.0
Scabies	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Eye, ear, nose and mouth infections	28	6.5	7	12.1	2	2.2	8	7.0	0	0.0	0	0.0	2	5.6
Conjunctivitis	17	3.9	6	10.3	1	1.1	6	5.2	0	0.0	0	0.0	0	0.0
Ear infections	3	0.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	5.6
Sinusitis	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Oral candidiasis	8	1.9	1	1.7	1	1.1	2	1.7	0	0.0	0	0.0	0	0.0
Gastrointestinal infections	12	2.8	1	1.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

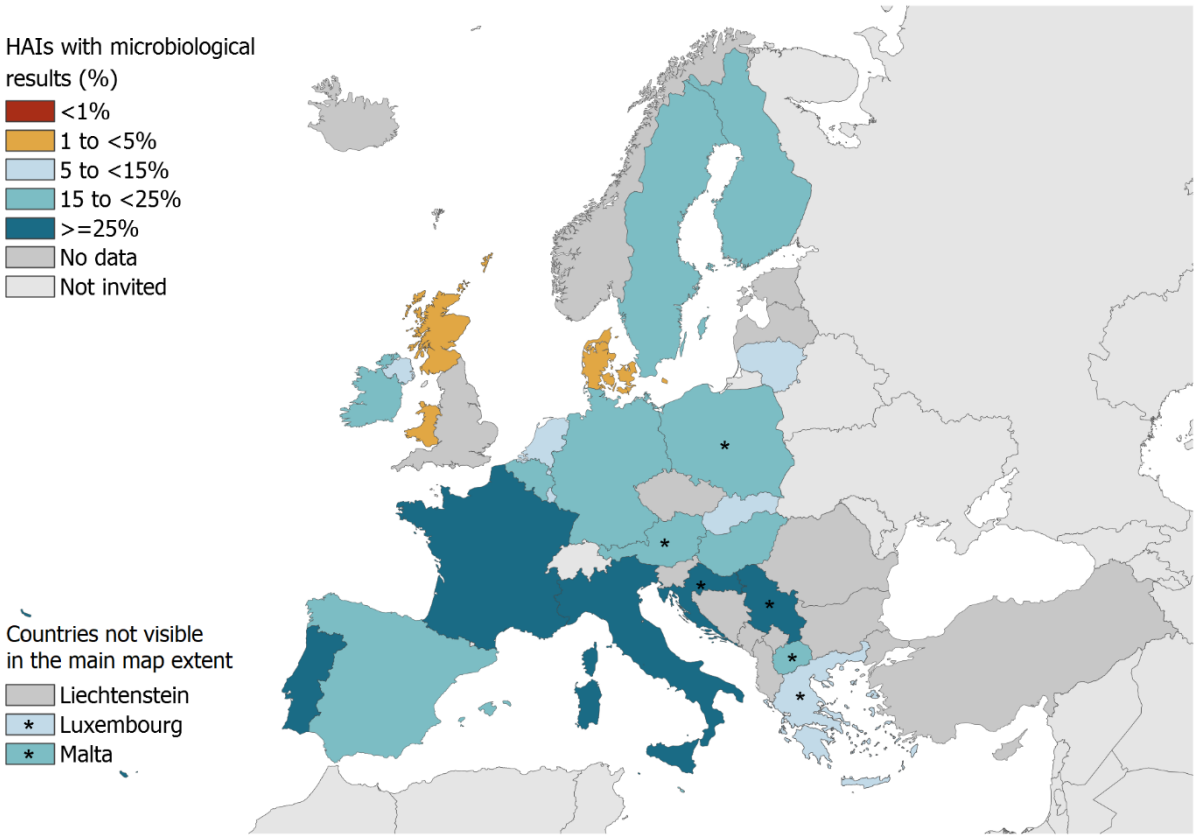
Types of HAI	Spain		Sweden[a]		UK- Northern Ireland		UK- Scotland		UK- Wales		North Macedonia*		Serbia*	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Gastroenteritis	8	1.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Clostridioides difficile infection	4	0.9	1	1.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Surgical site infections (SSIs)	3	0.7	0	0.0	1	1.1	1	0.9	0	0.0	0	0.0	0	0.0
Superficial SSI	1	0.2	0	0.0	1	1.1	1	0.9	0	0.0	0	0.0	0	0.0
Deep SSI	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Organ/space SSI	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Bloodstream infections	4	0.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Unexplained fever	2	0.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	2.8
Other infections	23	5.3	0	0.0	0	0.0	1	0.9	3	5.2	0	0.0	0	0.0

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); [b] HALT-3, 'flu' was defined as fever: a) single >37.8 °C oral/tympanic membrane OR b) repeated >37.2 °C oral OR >37.5 °C rectal OR c) >1.1 °C above baseline from any site – and at least three of the following symptoms: chills, new headache or eye pain, myalgia or body aches, malaise or loss of appetite, sore throat, or new/increased dry cough; No data for Cyprus and Czechia.*

Isolated microorganisms and antimicrobial resistance

The percentage of HAIs with documented positive microbiological results was 19.2% and ranged from 1.6% in UK-Scotland to 39.4% in Portugal. Microbiological results were not available for Norway, which reported aggregated HAIs from its national surveillance (Figure 14).

Figure 14. Percentage of HAIs with documented positive microbiological results available on the day of the PPS, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample; Negative results: a negative (i.e. sterile) culture from a microbiological sample, microorganism not identifiable, result not (yet) available or unknown, or examination not done.*

Microbiological data were not available for 75.8% of the HAIs at the time of the PPS for the following reasons: a) no microbiological examination was done (46.7%); b) the results were not available or unknown at that LTCF (29.1%); c) no microorganism was identified in the microbiological sample (4.1%); or d) a microbiological culture was negative, i.e. sterile (0.9%) (Table 19).

Table 19. Availability of microbiological results on the day of the PPS, by country/administration, HALT-3, 2016–2017

Country/Administration	N of HAIs	Microbiological result								N of isolated and identified microorganisms
		Examination not done or result not available or unknown		Microorganism not identifiable		Negative culture		Positive result		
		n	%	n	%	n	%	n	%	
Austria*	107	85	79.4	0	0.0	0	0.0	22	20.6	25
Belgium	364	273	75.0	10	2.7	4	1.1	77	21.2	90
Croatia*	15	10	66.7	0	0.0	0	0.0	5	33.3	8
Denmark	180	172	95.6	0	0.0	0	0.0	8	4.4	8
Finland	215	146	67.9	14	6.5	2	0.9	53	24.7	60

Country/Administration	N of HAIs	Microbiological result								N of isolated and identified microorganisms
		Examination not done or result not available or unknown		Microorganism not identifiable		Negative culture		Positive result		
		n	%	n	%	n	%	n	%	
France[a]†	206	152	73.8	1	0.5	0	0.0	53	25.7	56
Germany	115	97	84.3	0	0.0	0	0.0	18	15.7	21
Greece*	52	47	90.4	0	0.0	0	0.0	5	9.6	7
Hungary	73	60	82.2	0	0.0	2	2.7	11	15.1	19
Ireland	285	230	80.7	12	4.2	0	0.0	43	15.1	49
Italy	456	325	71.3	11	2.4	1	0.2	119	26.1	137
Lithuania	32	30	93.8	0	0.0	0	0.0	2	6.3	3
Luxembourg*	30	27	90.0	0	0.0	0	0.0	3	10.0	3
Malta*	81	46	56.8	4	4.9	14	17.3	17	21.0	20
Netherlands[a]†	160	133	83.1	9	5.6	0	0.0	18	11.3	21
Norway[a]†	119	119	100.0	0	-	-	-	-	-	-
Poland*	92	75	81.5	1	1.1	0	0.0	16	17.4	25
Portugal	226	103	45.6	31	13.7	3	1.3	89	39.4	97
Slovakia	112	88	78.6	8	7.1	0	0.0	16	14.3	20
Spain	598	386	64.5	55	9.2	8	1.3	149	24.9	182
Sweden[a]	58	49	84.5	0	0.0	0	0.0	9	15.5	10
UK-Northern Ireland	98	91	92.9	2	2.0	0	0.0	5	5.1	5
UK-Scotland	126	124	98.4	0	0.0	0	0.0	2	1.6	2
UK-Wales	58	56	96.6	0	0.0	0	0.0	2	3.4	2
Total	**3 858**	**2 924**	**75.8**	**158**	**4.1**	**34**	**0.9**	**742**	**19.2**	**870**
North Macedonia*	10	8	80.0	0	0.0	0	0.0	2	20.0	2
Serbia*	41	16	39.0	11	26.8	1	2.4	13	31.7	16

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); † Data imputed for infections that are not collected in national surveys: microbiological results for these are considered as unknown; -: not available; No data for Cyprus and Czechia.*

A microorganism was isolated and identified for 870 HAIs (Table 20). The ten most frequently isolated microorganisms were *Escherichia coli* (30.7%), *Staphylococcus aureus* (12.3%), *Klebsiella pneumoniae* (9.8%), *Proteus mirabilis* (9.5%), *Pseudomonas aeruginosa* (7.1%), *Clostridioides difficile* (4.4%), *Enterococcus faecalis* (3.8%), *Enterobacter cloacae* (1.7%), *Morganella* species (1.6%) and *Providencia* species (1.2%). Overall, Enterobacterales accounted for 57.8% of all reported isolates. These percentages should be interpreted with caution as the number of isolates were relatively low, and these vary from one country to another.

Table 20. Number and relative frequency (percentage) of the most commonly reported microorganisms for HAIs, by country/administration, HALT-3, 2016–2017

Country/Administration	N of isolates	*Staphylococcus aureus*		*Enterococcus* spp.		Enterobacterales										*Pseudomonas aeruginosa*		*Acinetobacter baumannii*		*Clostridioides difficile*	
						Subtotal		*Escherichia coli*		*Proteus* spp.		*Klebsiella* spp.		*Enterobacter* spp.							
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Austria*	25	5	20.0	0	0.0	12	48.0	8	32.0	1	4.0	3	12.0	0	0.0	0	0.0	0	0.0	3	12.0
Belgium	90	6	6.7	2	2.2	63	70.0	35	38.9	12	13.3	10	11.1	3	3.3	9	10.0	0	0.0	1	1.1
Croatia*	8	1	12.5	3	37.5	4	50.0	3	37.5	1	12.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Denmark	8	3	37.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	37.5
Finland	60	5	8.3	2	3.3	44	73.3	31	51.7	3	5.0	6	10.0	0	0.0	2	3.3	0	0.0	1	1.7
France[a]	56	5	8.9	1	1.8	43	76.8	26	46.4	5	8.9	8	14.3	1	1.8	4	7.1	0	0.0	0	0.0
Germany	21	1	4.8	1	4.8	6	28.6	6	28.6	0	0.0	0	0.0	0	0.0	2	9.5	0	0.0	3	14.3
Greece*	7	1	14.3	1	14.3	5	71.4	4	57.1	1	14.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Hungary	19	2	10.5	2	10.5	9	47.4	5	26.3	4	21.1	0	0.0	0	0.0	1	5.3	0	0.0	2	10.5
Ireland	49	15	30.6	3	6.1	21	42.9	14	28.6	4	8.2	2	4.1	1	2.0	2	4.1	0	0.0	2	4.1
Italy	137	12	8.8	5	3.6	75	54.7	33	24.1	24	17.5	11	8.0	3	2.2	11	8.0	2	1.5	12	8.8
Lithuania	3	0	0.0	0	0.0	3	100	2	66.7	0	0.0	1	33.3	0	0.0	0	0.0	0	0.0	0	0.0
Luxembourg*	3	1	33.3	0	0.0	2	66.7	1	33.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Malta*	20	8	40.0	2	10.0	7	35.0	4	20.0	2	10.0	0	0.0	0	0.0	0	0.0	0	0.0	1	5.0
Netherlands[a]	21	3	14.3	1	4.8	14	66.7	7	33.3	4	19.0	1	4.8	2	9.5	0	0.0	0	0.0	0	0.0
Norway[a]	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Poland*	25	2	8.0	1	4.0	14	56.0	4	16.0	2	8.0	4	16.0	1	4.0	3	12.0	1	4.0	2	8.0
Portugal	97	12	12.4	0	0.0	63	64.9	29	29.9	10	10.3	22	22.7	0	0.0	7	7.2	1	1.0	0	0.0
Slovakia	20	2	10.0	2	10.0	12	60.0	5	25.0	3	15.0	4	20.0	0	0.0	1	5.0	0	0.0	0	0.0

Country/Administration	N of isolates	*Staphylococcus aureus*		*Enterococcus* spp.		Enterobacterales										*Pseudomonas aeruginosa*		*Acinetobacter baumannii*		*Clostridioides difficile*	
						Subtotal		*Escherichia coli*		*Proteus* spp.		*Klebsiella* spp.		*Enterobacter* spp.							
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Spain	182	16	8.8	15	8.2	98	53.8	43	23.6	16	8.8	27	14.8	6	3.3	20	11.0	0	0.0	7	3.8
Sweden[a]	10	2	20.0	1	10.0	4	40.0	3	30.0	0	0.0	0	0.0	1	10.0	0	0.0	0	0.0	1	10.0
UK-Northern Ireland	5	3	60.0	0	0.0	2	40.0	2	40.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
UK-Scotland	2	1	50.0	0	0.0	1	50.0	1	50.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
UK-Wales	2	1	50.0	0	0.0	1	50.0	1	50.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	**870**	**107**	**12.3**	**42**	**4.8**	**503**	**57.8**	**267**	**30.7**	**92**	**10.6**	**99**	**11.4**	**18**	**2.1**	**62**	**7.1**	**4**	**0.5**	**38**	**4.4**
North Macedonia*	2	0	0.0	0	0.0	1	50.0	0	0.0	0	0.0	1	50.0	0	0.0	1	50.0	0	0.0	0	0.0
Serbia*	16	0	0.0	3	18.8	10	62.5	3	18.8	5	31.3	2	12.5	0	0.0	1	6.3	0	0.0	0	0.0

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); -: not available; No data for Cyprus and Czechia.*

Antimicrobial susceptibility testing (AST) was performed for selected bacterium-antimicrobial combinations (n=718; Table 21).

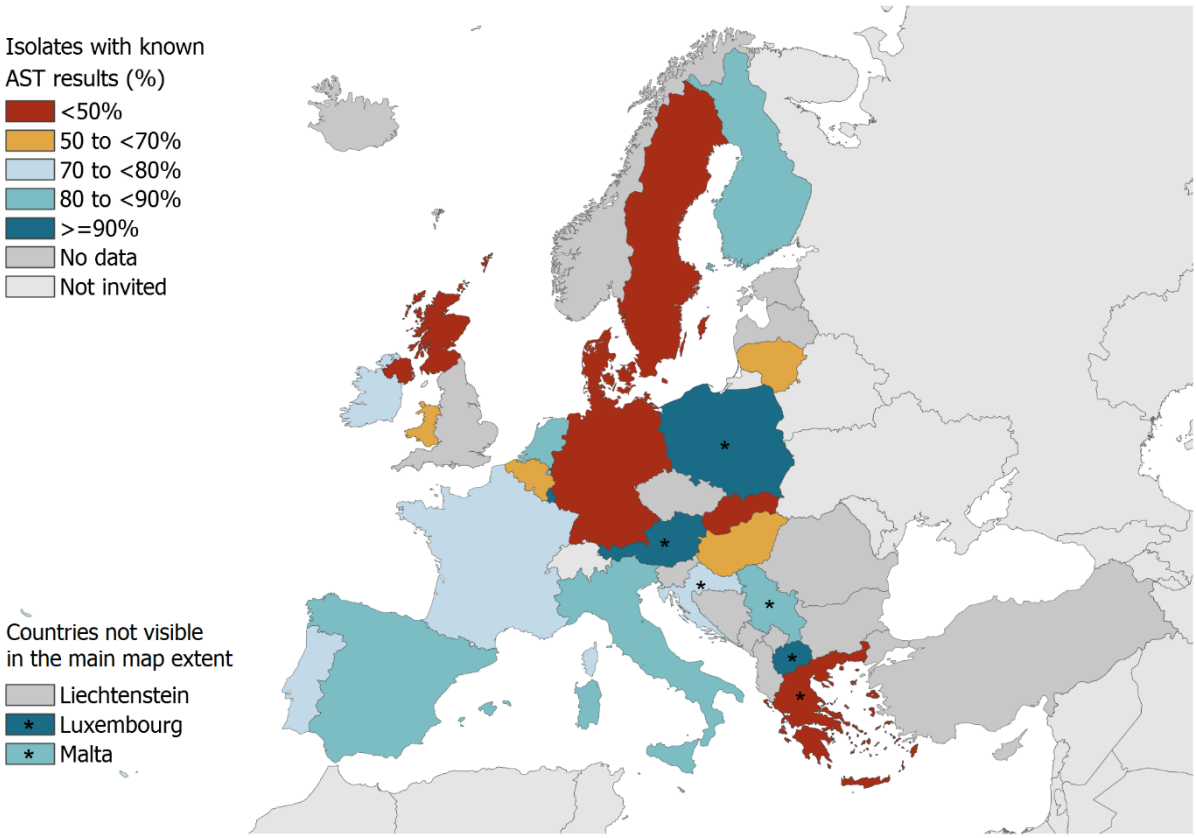
Table 21. Antimicrobial resistance markers in selected microorganisms, HALT-3, 2016–2017

Microorganism	N of isolates	Tested antibiotics[2]	Susceptible		Non-susceptible[3]		Unknown susceptibility	
			n	%	n	%	n	%
Staphylococcus aureus								
	107	OXA	45	42.1	42	39.3	20	18.7
		GLY	48	44.9	7	6.5	52	48.6
***Enterococcus* species,** including:								
Enterococcus faecalis	33	GLY	21	63.6	1	3.0	11	33.3
Enterococcus faecium	4	GLY	3	-	0	-	1	-
Enterococcus species, not specified or other	5	GLY	1	-	0	-	4	-
Enterobacterales[1], including:								
Escherichia coli	267	C3G	141	52.8	56	21.0	70	26.2
		CAR	185	69.3	10	3.7	72	27.0
Klebsiella species	99	C3G	55	55.6	27	27.3	17	17.2
		CAR	72	72.7	6	6.1	21	21.2
Enterobacter species	18	C3G	8	44.4	6	33.3	4	22.2
		CAR	14	77.8	0	0.0	4	22.2
Proteus species	92	C3G	53	57.6	16	17.4	23	25.0
		CAR	63	68.5	6	6.5	23	25.0
Citrobacter species	10	C3G	6	60.0	2	20.0	2	20.0
		CAR	8	80.0	0	0.0	2	20.0
Serratia species	3	C3G	2	-	1	-	0	-
		CAR	3	-	0	-	0	-
Morganella species	14	C3G	10	71.4	4	28.6	0	0.0
		CAR	12	85.7	1	7.1	1	7.1
Pseudomonas aeruginosa								
	62	CAR	44	71.0	7	11.3	11	17.7
Acinetobacter baumannii								
	4	CAR	1	-	2	-	1	-

-: Fewer than 10 isolates, percentage not calculated
[1] Antimicrobial resistance markers are not collected for other Enterobacterales (e.g. Hafnia spp., Salmonella spp., Shigella spp., Yersinia spp.)
[2] OXA: susceptibility to oxacillin, or other markers of MRSA, such as cefoxitin, cloxacillin, dicloxacillin, flucloxacillin, meticillin; GLY: susceptibility to glycopeptides, such as vancomycin or teicoplanin; 3GC: susceptibility to third-generation cephalosporins, such as cefotaxime, ceftriaxone, ceftazidime; CAR: susceptibility to carbapenems, such as imipenem, meropenem, doripenem.
[3] Non-susceptible: intermediate or resistant.

The percentage of microorganisms with antimicrobial susceptibility testing (AST) results that were known by the LTCF for first-level antimicrobial resistance (AMR) markers combined at the time of the survey was 77.6% overall, but varied from 0.0% in Denmark and UK-Scotland (n=5 microorganisms in total) to 100.0% in Luxembourg and Poland (n=24 in total) (Figure 15). First-level AMR markers included *Staphylococcus aureus* non-susceptible to oxacillin (MRSA), *Enterococcus faecium* or *Enterococcus faecalis* non-susceptible to glycopeptides, Enterobacterales non-susceptible to third-generation cephalosporins, *Pseudomonas aeruginosa* and *Acinetobacter baumannii* non-susceptible to carbapenems.

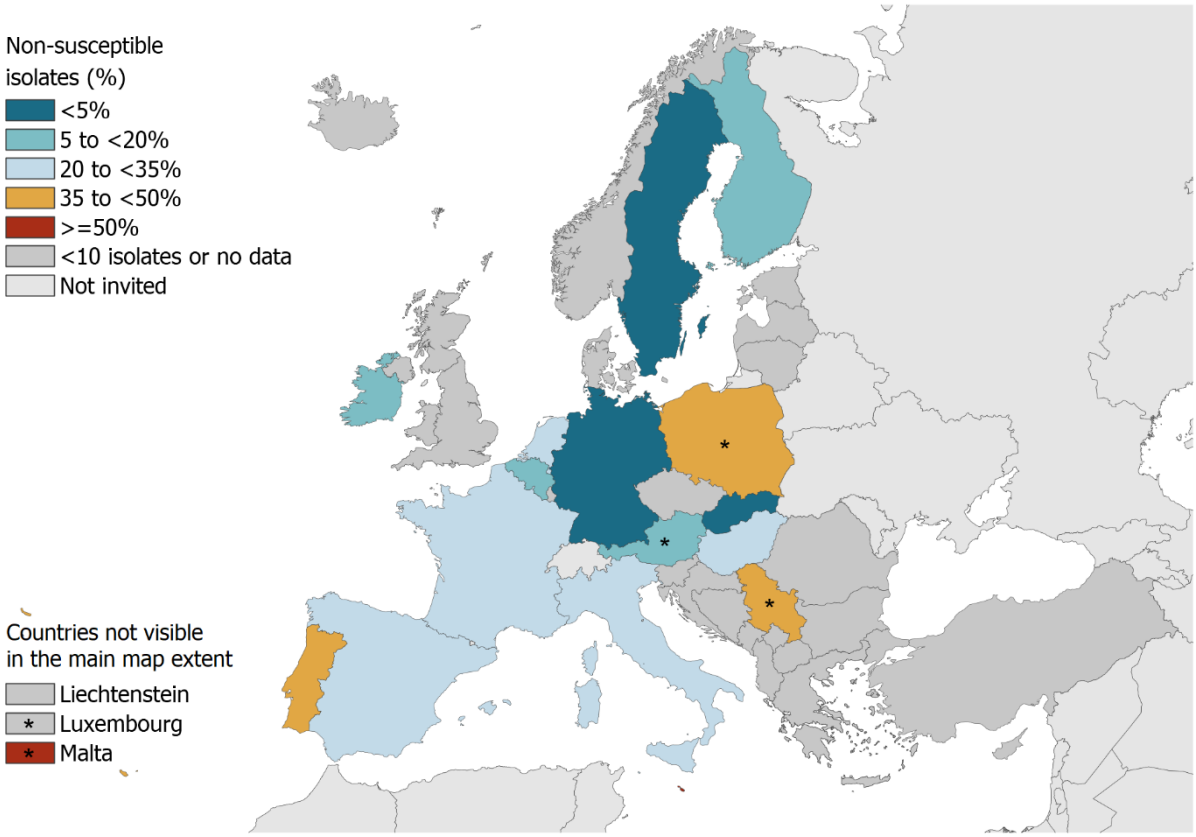
Figure 15. Percentage of isolates with known antimicrobial susceptibility testing results for selected[a] first-level antimicrobial resistance markers for HAIs, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample; [a] First-level AMR markers in HALT-3: Staphylococcus aureus non-susceptible to oxacillin, Enterococci faecalis or Enterococcus faecium non-susceptible to glycopeptides, Enterobacterales non-susceptible to third-generation cephalosporins, Pseudomonas aeruginosa and Acinetobacter baumannii non-susceptible to carbapenems.*

Of the 553 isolates for which AST results for first-level AMR markers were provided, 28.0% were non-susceptible to the antimicrobials included in the protocol. Non-susceptible isolates were not reported by Croatia (total isolates n=6), Germany (n=2), Luxembourg (n=3), Slovakia (n=8), and Sweden (n=3) while Lithuania and UK-Wales only reported two and one non-susceptible isolates, respectively (Figure 16).

Figure 16. Composite index of the percentage of isolates non-susceptible to selected first-level antimicrobial agents[a], by country, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample; [a] First-level AMR markers in HALT-3: MRSA, Enterococcus faecalis or faecium non-susceptible to glycopeptides, Enterobacterales non-susceptible to third-generation cephalosporins, Pseudomonas aeruginosa and Acinetobacter baumannii non-susceptible to carbapenems; Countries with <10 isolates with known antimicrobial susceptibility results not shown.*

LTCF risk adjustment model for HAIs

Characteristics of LTCFs and LTCF populations that are known to be associated with HAI prevalence were included in a multivariable linear regression model (Table 22). The model indicated that these characteristics only explained 20% of the variance in HAI prevalence (R^2=0.20).

HAI prevalence was associated with LTCF size, the proportion of residents with vascular and urinary catheters, with wounds other than pressure sores, age over 85, impaired mobility and disorientation. A 1% increase in the proportion of selected care load indicators and risk factors increased HAI prevalence by 25% for vascular catheters, 10% for other wounds and 4% for urinary catheters, respectively. For context, it is worth noting that overall median proportion of these risk factors in all LTCFs, are as follows: vascular catheters (0.0%); wounds other than pressure sores (3.5%); urinary catheter (5.6%).

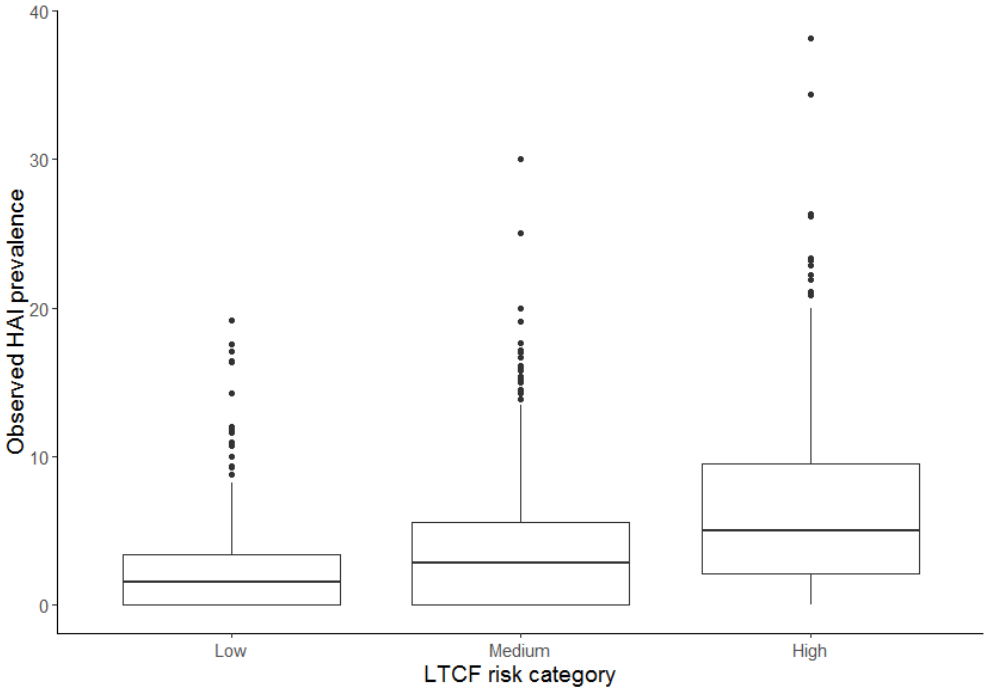
Table 22. Multivariable linear regression analysis of the association between LTCF and LTCF resident characteristics and the prevalence of HAIs, 21 countries/administrations*, 2016–2017

Characteristics	Coefficient (95% confidence interval)	p-value
Type of LTCF		
Residential home	Ref.	-
General nursing home	0.12 (-0.54–0.78)	0.721
Mixed	0.45 (-0.30–1.20)	0.237
Size of LTCF		
>95 beds	Ref.	-
57–95 beds	0.06 (-0.65–0.78)	0.859
35–56 beds	0.81 (0.07–1.54)	**0.032**
<35 beds	1.00 (0.27–1.72)	**0.007**
Characteristics of LTCF residents		
Aged over 85 years (%)	0.02 (0.00–0.03)	**0.045**
Male (%)	0.02 (-0.00–0.04)	0.112
Wheelchair-user or bedridden (%)	-0.02 (-0.03–-0.00)	**0.012**
Disoriented in time and/or space (%)	0.02 (0.00–0.03)	**0.012**
Urinary and/or faecal incontinence (%)	-0.00 (-0.02–0.01)	0.571
Pressure sore (%)	0.01 (-0.03–0.06)	0.538
Other wound (%)	0.10 (0.06–0.13)	**<0.001**
Surgery in the previous 30 days (%)	0.05 (-0.02–0.13)	0.187
Urinary catheter (%)	0.04 (0.01–0.08)	**0.007**
Vascular catheter (%)	0.25 (0.19–0.30)	**<0.001**

** France, Norway, Portugal, Sweden, North Macedonia and Serbia were excluded from the multivariable linear regression analysis (see Section 2, 'Methodology').*

Following the classification of the LTCFs to low-, medium- and high-risk LTCFs, the median HAI prevalence was 1.6% (interquartile range (IQR): 0.0–3.4%) in low-risk LTCFs (n=295), 2.8% (IQR: 0.0–5.6%) in medium-risk LTCFs (n=588), and 5.0% (IQR: 2.2–9.5%) in high-risk LTCFs (n=294; Figure 17).

Figure 17. HAI prevalence by the LTCF risk categories estimated by multivariable linear regression analysis, HALT-3, 2016–2017



3.2.7 Antimicrobial use

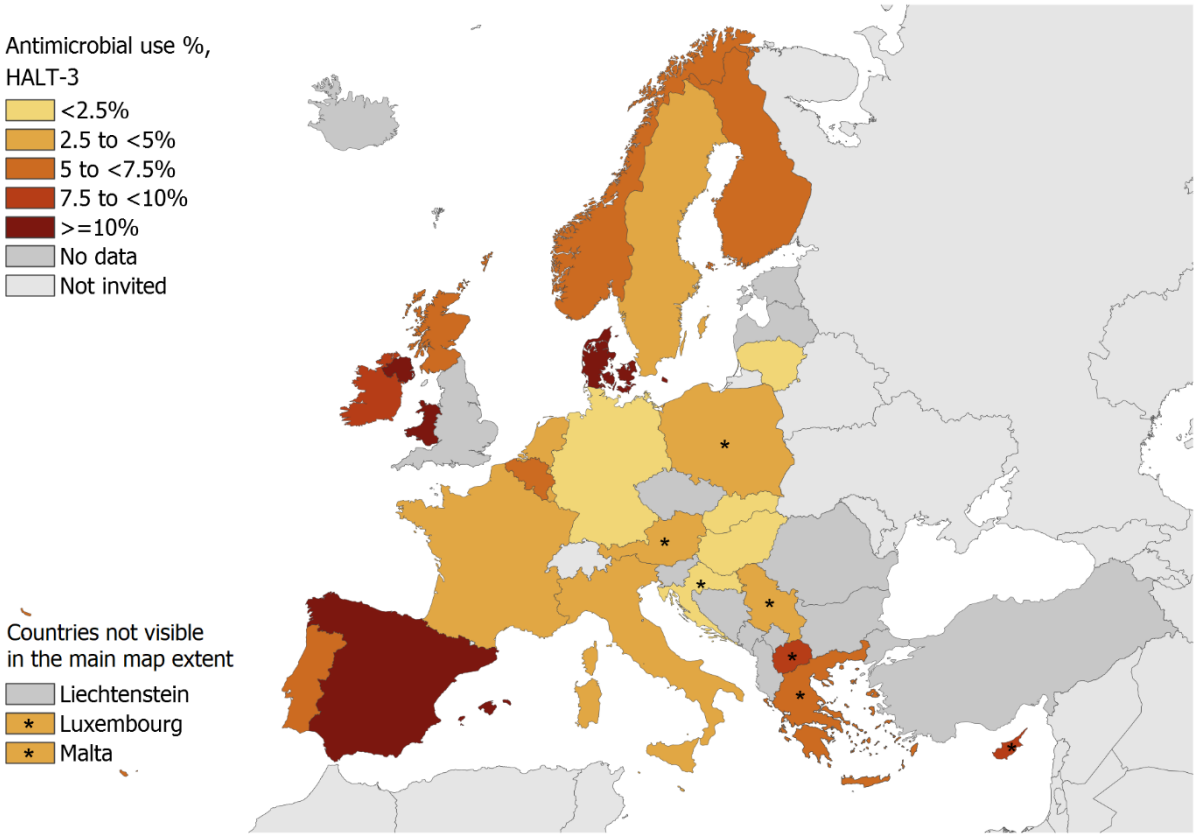
Prevalence of antimicrobial use

On the day of the PPS, 5 035 of the 102 301 eligible residents received at least one antimicrobial agent (crude prevalence: 4.9%; Table 23). Information on the antimicrobial agent(s) was provided by all the participating countries/administrations except Cyprus, thus leaving data on 5 006 residents for further analysis. In total, 5 344 antimicrobial agents were reported for these 5 006 residents, with 93.8% receiving one antimicrobial agent, 5.8% receiving two, and 0.4% receiving three or more.

The crude prevalence of residents with at least one antimicrobial agent was 4.9%. The median prevalence was 3.6% and ranged from 0.0% in Sweden to 10.8% in Spain (Figure 18, Table 23).

There were 527 LTCFs that reported no antimicrobial use on the day of the PPS, of which more than half were in Sweden (37.6%), Italy (8.9%) or Hungary (7.8%).

Figure 18. Prevalence of eligible LTCF residents receiving at least one antimicrobial agent on the day of the PPS, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample.*

Table 23. Number and prevalence of eligible LTCF residents receiving at least one antimicrobial agent on the day of the PPS, by country/administration, HALT-3, 2016–2017

Country/Administration	N of eligible residents	N of residents with at least one antimicrobial agent	Prevalence (%) of residents with at least one antimicrobial agent			
			Overall %	P25	Median	P75
Austria*	2 065	67	3.2	1.0	2.4	4.7
Belgium	8 206	482	5.9	2.9	5.1	8.1
Croatia*	1 607	32	2.0	0.8	3.6	4.9
Cyprus*	312	29	9.3	4.8	7.7	17.0
Czechia*	-	-	-	-	-	-
Denmark	3 346	350	10.5	6.3	9.0	15.0
Finland	5 914	394	6.7	2.3	5.9	10.5
France[a]	6 957	187	2.7	0.0	2.3	4.3
Germany	6 705	85	1.3	0.0	0.9	1.9
Greece*	812	49	6.0	3.0	4.2	11.6

Country/Administration	N of eligible residents	N of residents with at least one antimicrobial agent	Prevalence (%) of residents with at least one antimicrobial agent			
			Overall %	P25	Median	P75
Hungary	7 670	71	0.9	0.0	0.0	1.4
Ireland	5 613	543	9.7	5.4	8.6	14.7
Italy	11 417	495	4.3	0.8	3.1	6.6
Lithuania	3 438	25	0.7	0.0	0.0	1.0
Luxembourg*	1 616	42	2.6	0.9	1.5	4.2
Malta*	2 485	66	2.7	0.5	1.4	2.4
Netherlands[a]	4 547	202	4.4	1.6	4.3	6.7
Norway[a]	2 447	169	6.9	2.1	4.6	10.3
Poland*	2 281	73	3.2	0.9	2.9	6.5
Portugal	3 633	220	6.1	0.0	4.3	10.0
Slovakia	5 091	113	2.2	0.0	1.2	3.4
Spain	6 808	717	10.5	3.5	10.8	17.3
Sweden[a]	3 604	118	3.3	0.0	0.0	5.6
UK-Northern Ireland	2 614	270	10.3	5.0	9.8	14.3
UK-Scotland	2 147	138	6.4	0.0	5.1	10.9
UK-Wales	966	98	10.1	5.5	8.2	11.4
Total	**102 301**	**5 035**	**4.9**	**0.0**	**3.6**	**8.5**
North Macedonia*	294	26	8.8	2.5	5.1	7.9
Serbia*	1 168	57	4.9	3.7	4.0	5.5

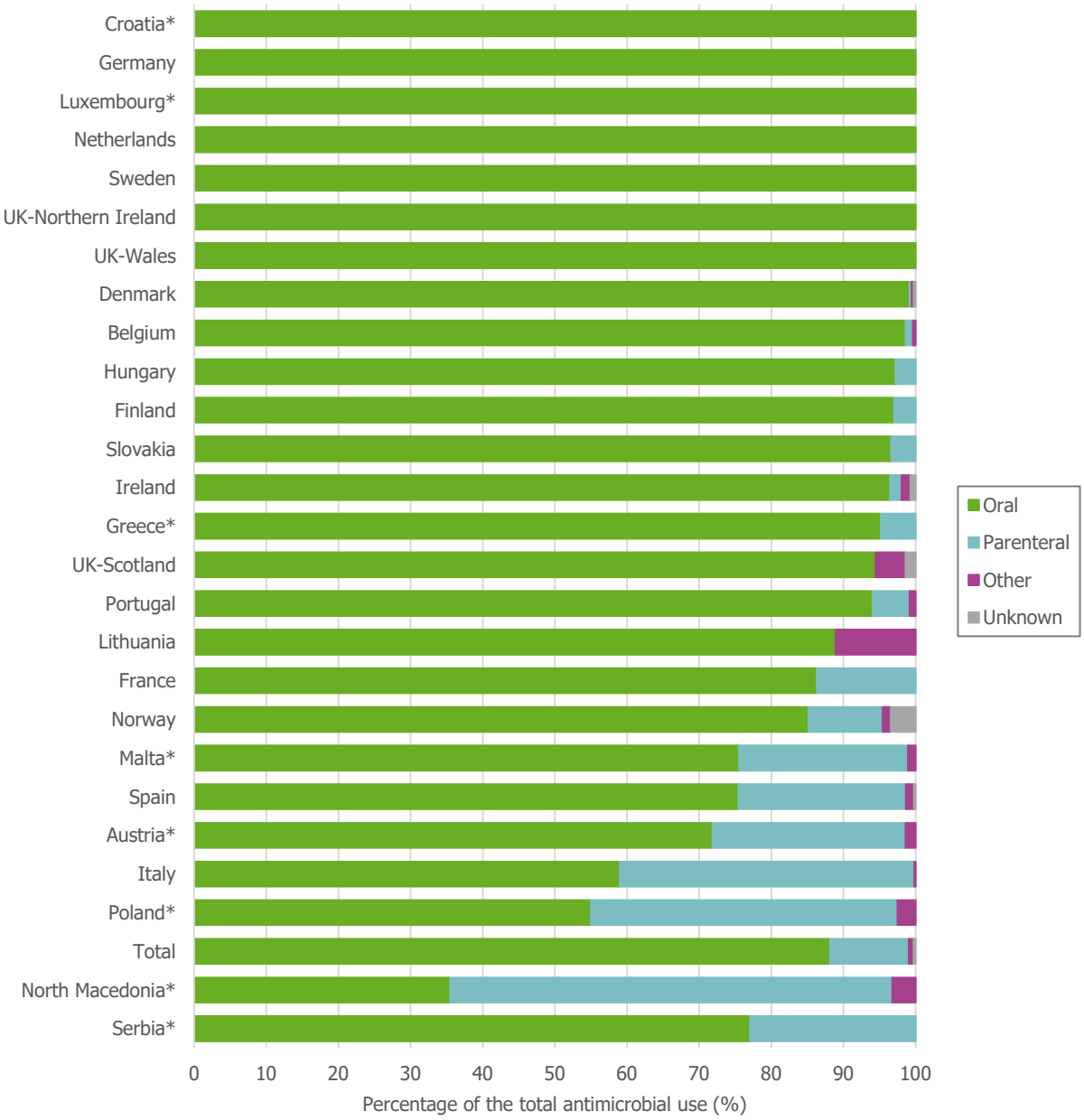
** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); -: no data available.*

Characteristics and indications for antimicrobial prescribing

Antimicrobials were mainly administered orally (88.1%). All antimicrobials were prescribed this way in seven countries/administrations (Croatia, Germany, Luxembourg, the Netherlands, Sweden, UK-Northern Ireland and UK-Wales; Figure 19).

A parenteral route (intramuscular, intravenous or subcutaneous) was used for 10.9% of the agents. The proportion was the highest in Poland (42.5%) and Italy (40.8%). Additionally, another administration route (e.g. rectal, inhalation) was used for 0.7% of the agents. The route of administration was not recorded for 15 antimicrobial agents (0.3%; Figure 19).

Figure 19. Route of administration of antimicrobial agents, by country/administration, HALT-3, 2016–2017

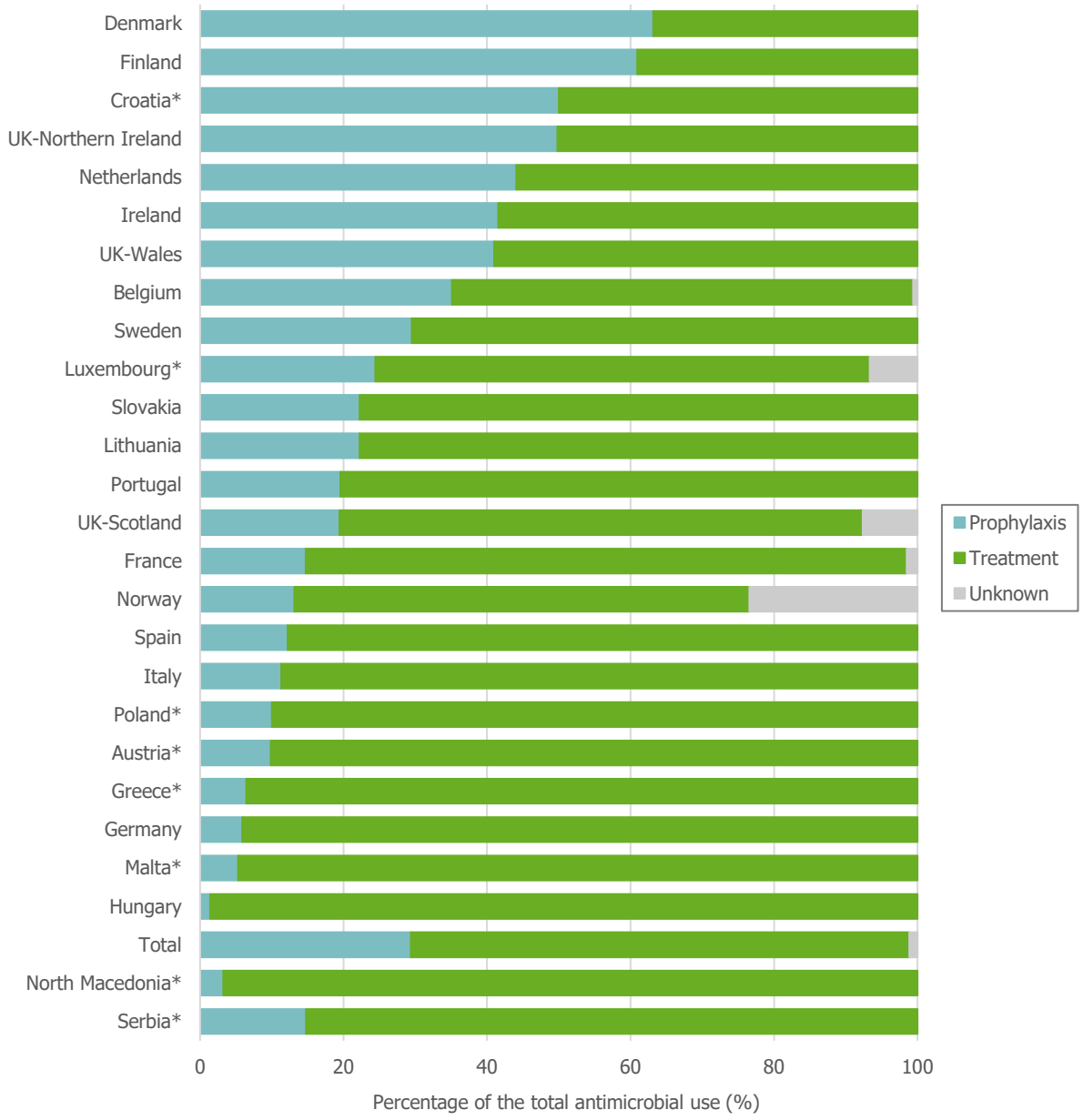


** Poor or very poor national representativeness of the LTCF sample; No data for Cyprus and Czechia.*

LTCFs reported that antimicrobials were mainly prescribed within the LTCF itself (77.9%), while 12.9% were prescribed in a hospital and 5.1% elsewhere. The place of prescription was unknown for 224 antimicrobials (4.2%).

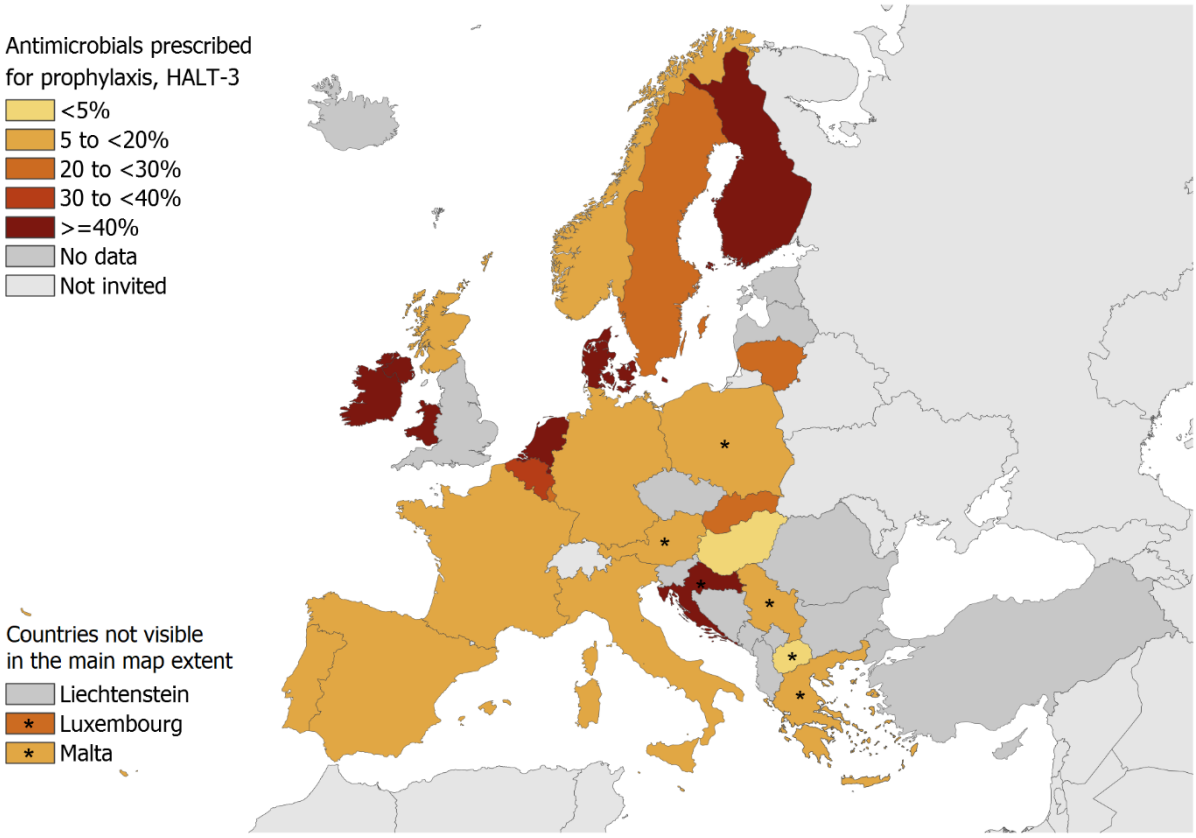
The main indication for the antimicrobial prescriptions was for treatment (69.5%) rather than prophylaxis (29.4%), while the indication was unknown for 1.1% of the antimicrobials. While more than 90% of all antimicrobials were prescribed for treatment in Hungary (98.6%), Malta (94.7%), Germany (94.1%), Greece (93.5%) and Austria (90.1%), prophylaxis accounted for at least half of all prescriptions in Denmark (63.2%), Finland (60.9%) and Croatia (50.0%) (Figures 20 and 21).

Figure 20. Indication for antimicrobial use, by country/administration, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample; No data for Cyprus and Czechia.*

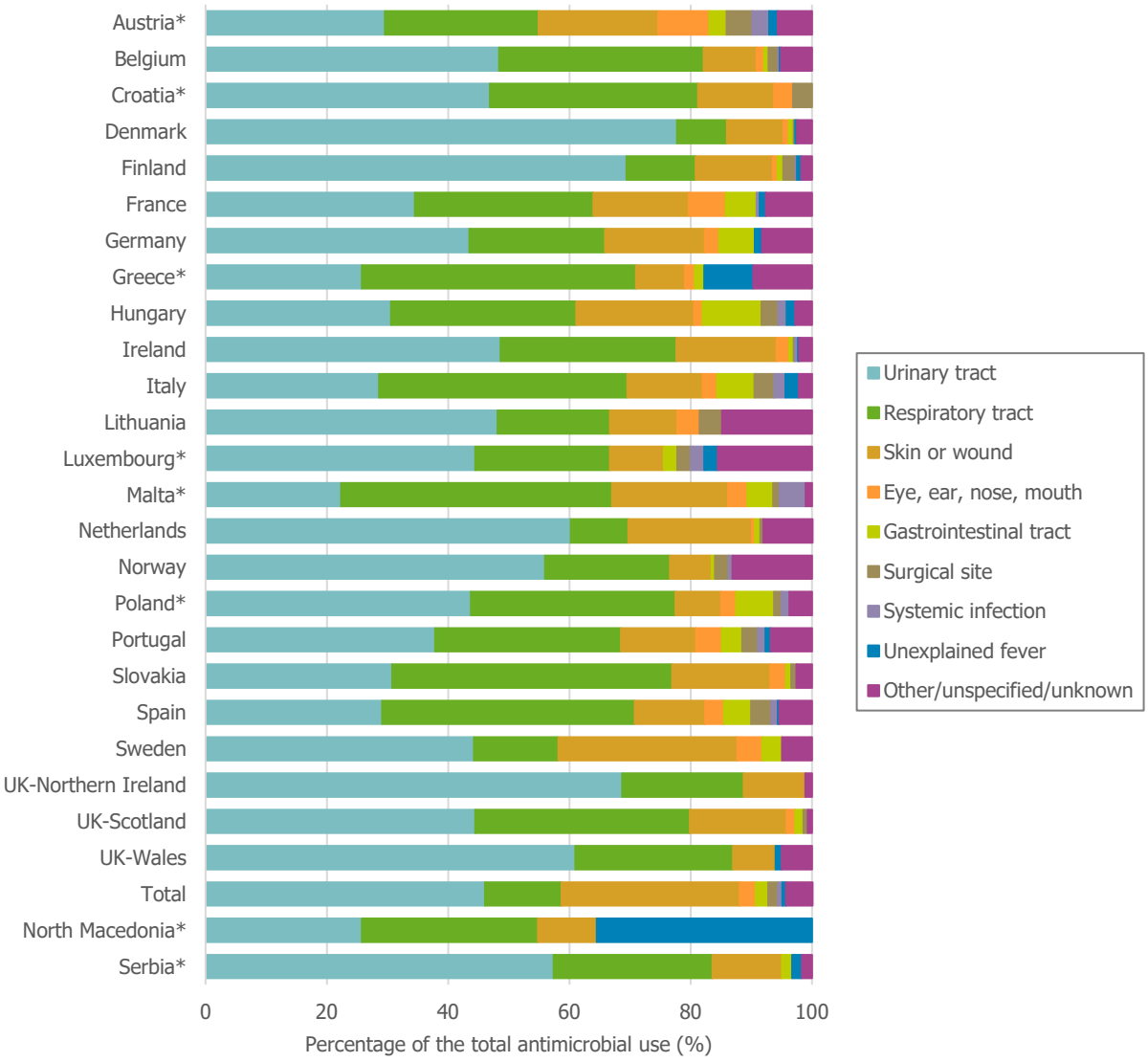
Figure 21. Proportion of antimicrobials prescribed for prophylaxis, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample.*

The overwhelming majority of antimicrobials were prescribed as prophylaxis or treatment for UTIs (46.1%), RTIs (29.4%) and skin or wound infections (12.6%). UTIs were the most common indication for prescriptions in all countries except for Greece, Italy, Malta, Slovakia and Spain where RTIs were the main indication. Figure 22 shows the sites of diagnosis for antimicrobial use by country, irrespective of indication. Tables 24 and 25 present the sites of diagnosis for antimicrobial prophylaxis and treatment, respectively.

Figure 22. Sites of diagnosis for antimicrobial use, by country/administration, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample; No data for Cyprus and Czechia.*

Table 24. Sites of diagnosis or indication for antimicrobial prophylaxis, by country/administration, HALT-3, 2016–2017

Country/ Administration	Antimicrobials	Urinary tract		Genital tract		Skin or wound		Respiratory tract		Gastrointestinal tract		Eye, ear, nose, mouth		Surgical site		Tuberculosis		Systemic infection		Unexplained fever		Other		Unknown	
	n	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Austria*	7	0	0.0	0	0.0	2	28.6	1	14.3	1	14.3	1	14.3	1	14.3	0	0.0	0	0.0	0	0.0	1	14.3	0	0.0
Belgium	177	137	77.4	2	1.1	6	3.4	21	11.9	1	0.6	0	0.0	1	0.6	0	0.0	1	0.6	0	0.0	4	2.3	4	2.3
Croatia*	16	6	37.5	0	0.0	3	18.8	6	37.5	0	0.0	1	6.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Denmark	230	217	94.3	2	0.9	6	2.6	3	1.3	1	0.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0
Finland	245	217	88.6	0	0.0	14	5.7	6	2.4	0	0.0	0	0.0	5	2.0	0	0.0	0	0.0	0	0.0	3	1.2	0	0.0
France[a]	29	14	48.3	0	0.0	0	0.0	6	20.7	3	10.3	2	6.9	0	0.0	0	0.0	0	0.0	0	0.0	4	13.8	0	0.0
Germany	5	4	80.0	0	0.0	1	20.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Greece*	4	2	50.0	1	25.0	1	25.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Hungary	1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	100	0	0.0
Ireland	234	182	77.8	1	0.4	12	5.1	30	12.8	0	0.0	1	0.4	0	0.0	0	0.0	2	0.9	0	0.0	6	2.6	0	0.0
Italy	62	14	22.6	0	0.0	4	6.5	15	24.2	11	17.7	4	6.5	5	8.1	0	0.0	2	3.2	2	3.2	5	8.1	0	0.0
Lithuania	6	5	83.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	16.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Luxembourg*	11	6	54.5	2	18.2	1	9.1	0	0.0	0	0.0	0	0.0	1	9.1	0	0.0	0	0.0	0	0.0	0	0.0	1	9.1
Malta*	5	0	0.0	0	0.0	3	60.0	2	40.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Netherlands[a]	93	57	61.3	0	0.0	3	3.2	21	22.6	0	0.0	1	1.1	0	0.0	0	0.0	0	0.0	0	0.0	11	11.8	0	0.0
Norway[a]	23	23	100	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Poland*	8	8	100	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Portugal	46	15	32.6	0	0.0	5	10.9	9	19.6	4	8.7	0	0.0	1	2.2	0	0.0	2	4.3	1	2.2	9	19.6	0	0.0
Slovakia	26	15	57.7	0	0.0	2	7.7	6	23.1	0	0.0	1	3.8	1	3.8	1	3.8	0	0.0	0	0.0	0	0.0	0	0.0
Spain	100	21	21.0	0	0.0	5	5.0	42	42.0	16	16.0	2	2.0	6	6.0	0	0.0	1	1.0	0	0.0	7	7.0	0	0.0

Country/ Administration	Antimicrobials	Urinary tract		Genital tract		Skin or wound		Respiratory tract		Gastrointestinal tract		Eye, ear, nose, mouth		Surgical site		Tuberculosis		Systemic infection		Unexplained fever		Other		Unknown	
	n	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Sweden[a]	36	30	83.3	0	0.0	4	11.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	5.6
UK-Northern Ireland	137	129	94.2	0	0.0	1	0.7	6	4.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.7	0	0.0
UK-Scotland	28	24	85.7	0	0.0	2	7.1	1	3.6	1	3.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
UK-Wales	41	36	87.8	0	0.0	1	2.4	2	4.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	2.4	1	2.4	0	0.0
Total	**1 570**	**1 162**	**74.0**	**8**	**0.5**	**76**	**4.8**	**177**	**11.3**	**38**	**2.4**	**13**	**0.8**	**22**	**1.4**	**1**	**0.1**	**8**	**0.5**	**4**	**0.3**	**54**	**3.4**	**7**	**0.4**
North Macedonia*	1	0	0.0	0	0.0	0	0.0	1	100	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Serbia*	9	5	55.6	1	11.1	3	33.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); No data for Cyprus and Czechia.*

Table 25. Sites of diagnosis or indication for antimicrobial treatment, by country/administration, HALT-3, 2016—2017

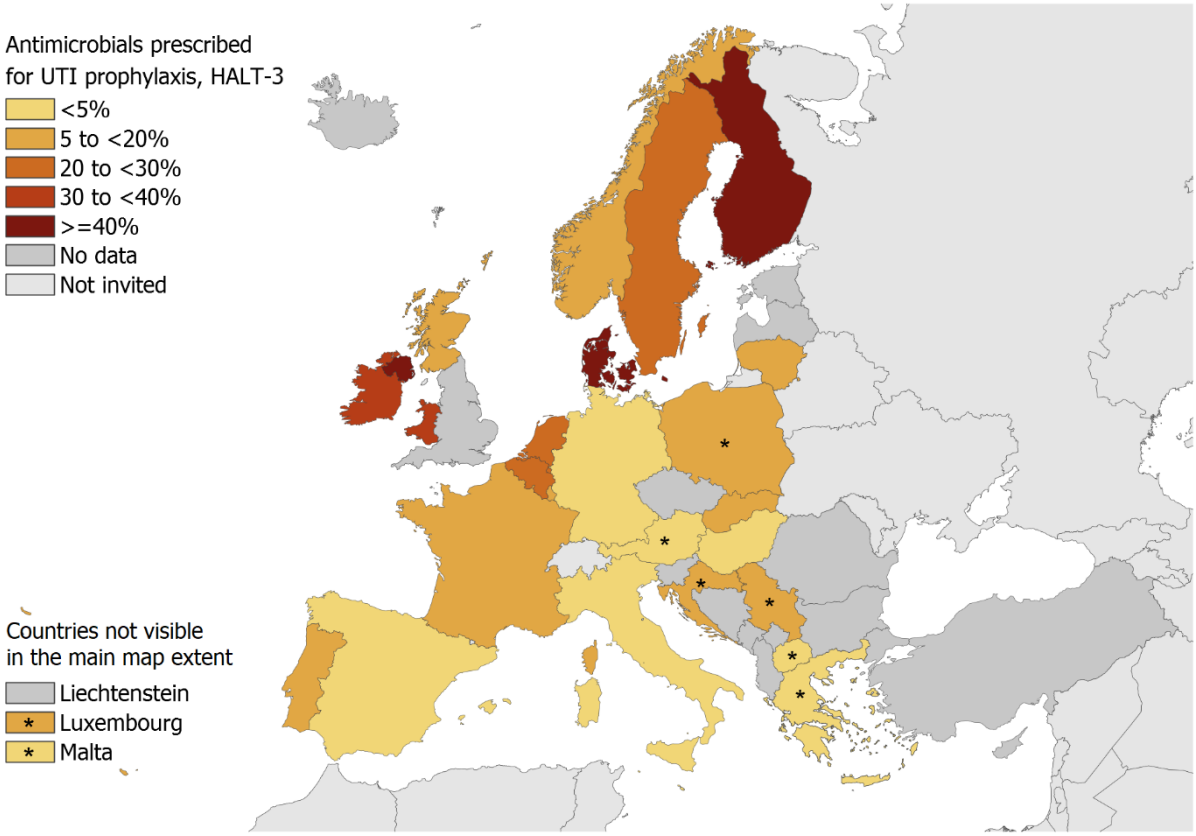
Country/ Administration	Antimicrobials	Urinary tract		Genital tract		Skin or wound		Respiratory tract		Gastrointestinal tract		Eye, ear, nose, mouth		Surgical site		Tuberculosis		Systemic infection		Unexplained fever		Other		Unknown	
	n	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Austria*	64	21	32.8	0	0.0	12	18.8	17	26.6	1	1.6	5	7.8	2	3.1	0	0.0	2	3.1	1	1.6	3	4.7	0	0.0
Belgium	324	106	32.7	6	1.9	37	11.4	148	45.7	3	0.9	6	1.9	7	2.2	0	0.0	0	0.0	1	0.3	9	2.8	1	0.3
Croatia*	16	9	56.3	0	0.0	1	6.3	5	31.3	0	0.0	0	0.0	1	6.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Denmark	134	66	49.3	0	0.0	28	20.9	27	20.1	2	1.5	3	2.2	1	0.7	0	0.0	0	0.0	1	0.7	6	4.5	0	0.0
Finland	157	62	39.5	2	1.3	37	23.6	40	25.5	4	2.5	3	1.9	3	1.9	0	0.0	1	0.6	3	1.9	2	1.3	0	0.0
France[a]	165	54	32.7	0	0.0	30	18.2	52	31.5	7	4.2	10	6.1	0	0.0	0	0.0	1	0.6	2	1.2	9	5.5	0	0.0
Germany	80	33	41.3	2	2.5	13	16.3	19	23.8	5	6.3	2	2.5	0	0.0	0	0.0	0	0.0	1	1.3	5	6.3	0	0.0
Greece*	58	14	24.1	0	0.0	4	6.9	28	48.3	1	1.7	1	1.7	0	0.0	0	0.0	0	0.0	5	8.6	5	8.6	0	0.0
Hungary	71	22	31.0	0	0.0	14	19.7	22	31.0	7	9.9	1	1.4	2	2.8	0	0.0	1	1.4	1	1.4	1	1.4	0	0.0
Ireland	329	92	28.0	3	0.9	81	24.6	133	40.4	4	1.2	11	3.3	1	0.3	0	0.0	1	0.3	1	0.3	2	0.6	0	0.0
Italy	487	143	29.4	2	0.4	64	13.1	210	43.1	23	4.7	9	1.8	13	2.7	0	0.0	8	1.6	10	2.1	5	1.0	0	0.0
Lithuania	21	8	38.1	1	4.8	3	14.3	5	23.8	0	0.0	1	4.8	0	0.0	3	14.3	0	0.0	0	0.0	0	0.0	0	0.0
Luxembourg*	31	14	45.2	0	0.0	3	9.7	9	29.0	1	3.2	0	0.0	0	0.0	3	9.7	0	0.0	1	3.2	0	0.0	0	0.0
Malta*	89	21	23.6	1	1.1	15	16.9	40	44.9	4	4.5	3	3.4	1	1.1	0	0.0	4	4.5	0	0.0	0	0.0	0	0.0
Netherlands[a]	118	70	59.3	0	0.0	17	14.4	22	18.6	1	0.8	1	0.8	1	0.8	0	0.0	0	0.0	0	0.0	6	5.1	0	0.0
Norway[a]	111	58	52.3	0	0.0	7	6.3	35	31.5	1	0.9	0	0.0	4	3.6	0	0.0	0	0.0	0	0.0	6	5.4	0	0.0
Poland*	72	27	37.5	2	2.8	6	8.3	27	37.5	5	6.9	2	2.8	1	1.4	0	0.0	1	1.4	0	0.0	1	1.4	0	0.0
Portugal	189	74	39.2	1	0.5	24	12.7	63	33.3	4	2.1	10	5.3	5	2.6	3	1.6	1	0.5	1	0.5	3	1.6	0	0.0
Slovakia	91	21	23.1	0	0.0	17	18.7	48	52.7	1	1.1	2	2.2	0	0.0	0	0.0	0	0.0	0	0.0	2	2.2	0	0.0
Spain	718	217	30.2	2	0.3	90	12.5	299	41.6	21	2.9	23	3.2	21	2.9	5	0.7	8	1.1	2	0.3	30	4.2	0	0.0

Country/ Administration	Antimicrobials	Urinary tract		Genital tract		Skin or wound		Respiratory tract		Gastrointestinal tract		Eye, ear, nose, mouth		Surgical site		Tuberculosis		Systemic infection		Unexplained fever		Other		Unknown	
	n	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Sweden[a]	86	24	27.9	0	0.0	32	37.2	17	19.8	4	4.7	5	5.8	0	0.0	0	0.0	0	0.0	0	0.0	4	4.7	0	0.0
UK-Northern Ireland	138	60	43.5	1	0.7	27	19.6	49	35.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.7	0	0.0
UK-Scotland	105	36	34.3	0	0.0	20	19.0	44	41.9	1	1.0	2	1.9	1	1.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.0
UK-Wales	59	25	42.4	0	0.0	6	10.2	24	40.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	6.8	0	0.0
Total	**3 713**	**1 277**	**34.4**	**23**	**0.6**	**588**	**15.8**	**1 383**	**37.2**	**100**	**2.7**	**100**	**2.7**	**64**	**1.7**	**14**	**0.4**	**28**	**0.8**	**30**	**0.8**	**104**	**2.8**	**2**	**0.1**
North Macedonia*	30	8	26.7	0	0.0	3	10.0	8	26.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	11	36.7	0	0.0	0	0.0
Serbia*	52	30	57.7	0	0.0	4	7.7	16	30.8	1	1.9	0	0.0	0	0.0	0	0.0	0	0.0	1	1.9	0	0.0	0	0.0

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); No data for Cyprus and Czechia.*

Out of 1 570 antimicrobials prescribed as prophylaxis, 74.0% were for the prevention of UTIs. Otherprophylactic prescriptions were for skin or wound infections (11.3%) and RTIs (4.8%). In all but four countries (Hungary, Italy, Malta, Spain), UTI prophylaxis accounted for the majority of prophylactic antimicrobial use. In Hungary, all prophylactic prescriptions were for UTIs, except for one which was prescribed for a non-specified infection. RTIs were the predominant indication for prophylaxis in Italy and Spain. In Malta, three out of five antimicrobial agents were prescribed for the prevention of a skin or wound infection, while the remainder were for RTIs (Table 24). Figure 23 presents the proportion of all antimicrobial agents prescribed for UTI prophylaxis by country.

Figure 23. Percentage of antimicrobial agents prescribed for UTI prophylaxis, by country/administration, HALT-3, 2016–2017

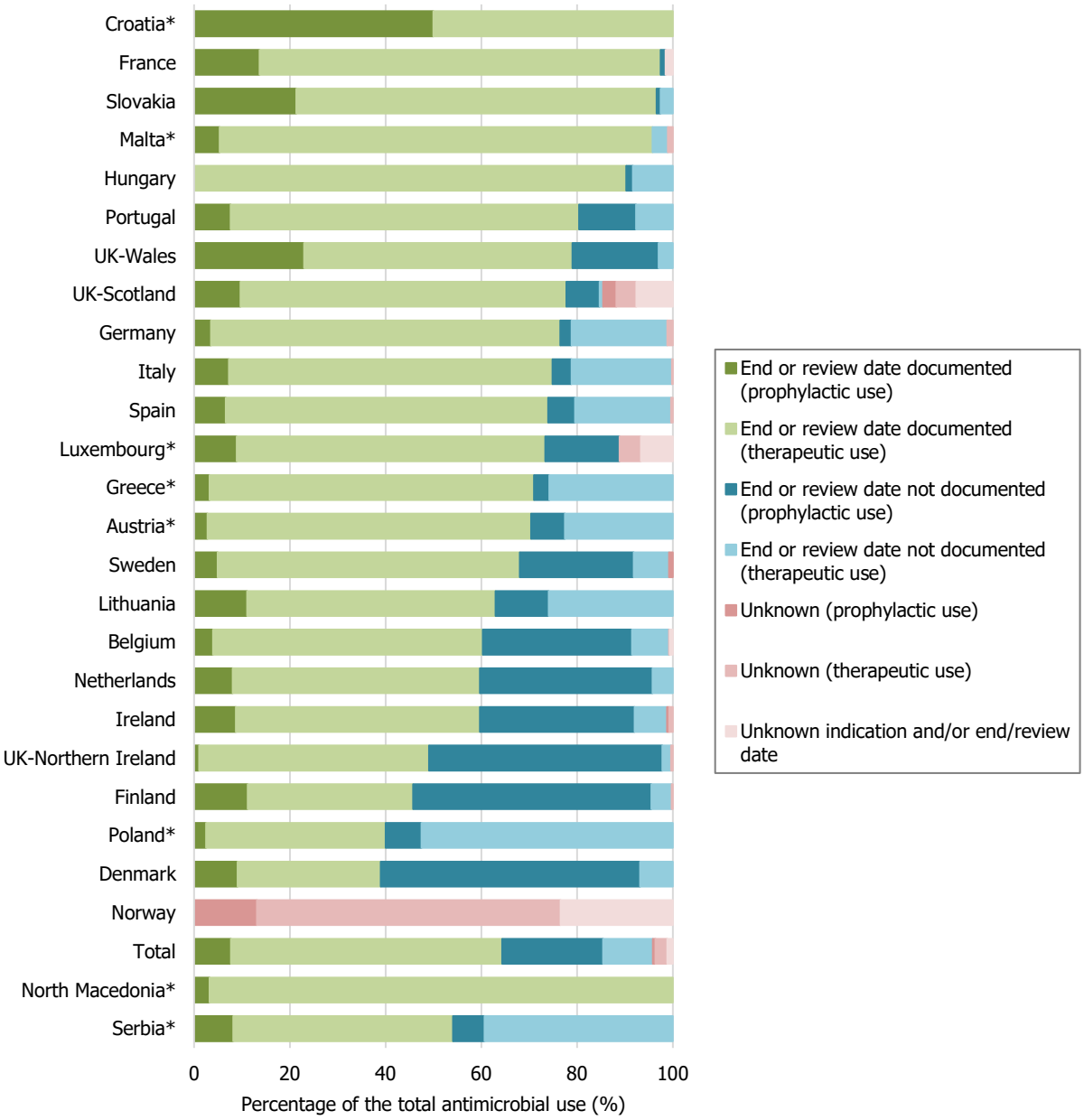


** Poor or very poor national representativeness of the LTCF sample.*

Out of 3 713 antimicrobials prescribed for treatment, 37.2% were for RTIs, 34.4% for UTIs and 15.8% for skin or wound infections. These three sites of diagnosis accounted for more than 80% of the antimicrobial agents prescribed for treatment in all the participating countries except Greece (79.3%) and Lithuania (76.2%) (Table 25).

An end or review date was documented in the residents' records for the majority (64.6%) of antimicrobial prescriptions. This percentage was much higher for treatment than for prophylaxis (81.6% and 26.2%, respectively; Figure 24). In Norway, information on the availability of an end or review date was not collected.

Figure 24. Availability of an 'end or review date for antimicrobial use' in the residents' records, by country/administration, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample; No data for Cyprus and Czechia; Norway did not collect data on an end or review date.*

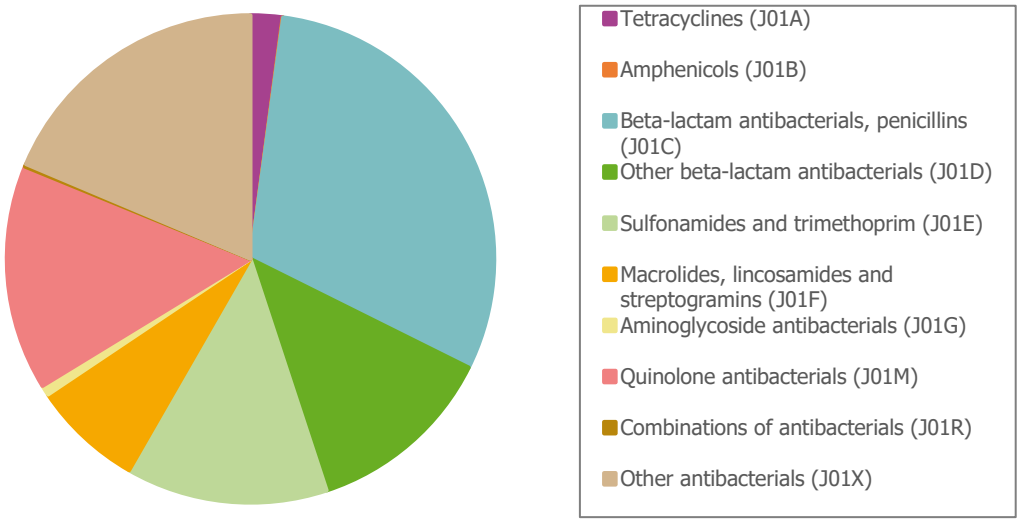
Antimicrobial agents prescribed in the LTCFs

The vast majority of the reported antimicrobial agents recorded during the survey were antibacterials for systemic use (ATC J01; n=5 098/5 344 or 95.4% of all antimicrobial agents). There were fewer reports of the other groups of antimicrobial agents included in this survey. These were nitroimidazole-derived antiprotozoals (ATC P01AB; 1.4%), antibiotics used as intestinal anti-infectives (ATC A07AA; 1.3%), antimycotics for systemic use (ATC J02; 1.2%), antimycobacterials used for treatment of tuberculosis (ATC J04A; 0.5%) and antifungals for systemic use (ATC D01BA; 0.2%).

Antibacterials for systemic use (ATC J01)

There were 5 098 reports of prescriptions of antibacterials for systemic use (ATC J01). The most frequently used sub-groups within this group were penicillins (J01C; 30.2%), 'other antibacterials' (J01X; 18.6%), quinolones (J01M, 14.9%), sulfonamides and trimethoprim (J01E; 13.3%) and other beta-lactam antibacterials (J01D; 12.6%) (Figure 25). Information on the subgroups of antibacterials for systemic use was not available for four prescriptions in Belgium and three prescriptions in Lithuania.

Figure 25. Distribution of use of antibacterials for systemic use (ATC J01; n=5 091), HALT-3, 2016–2017

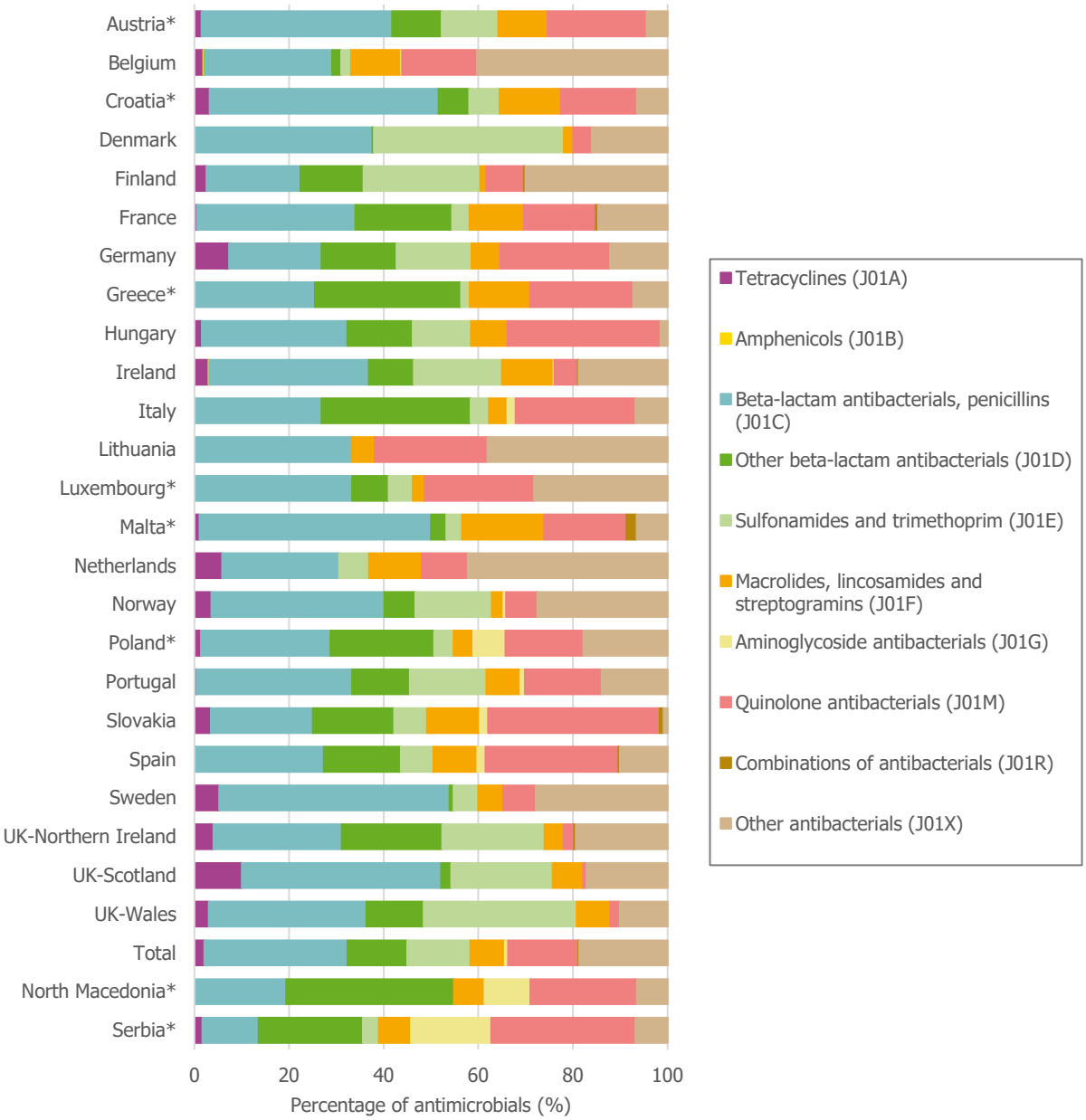


In 13 countries, the most commonly prescribed subgroup of antibacterials for systemic use (ATC J01) was penicillins (J01C; Figure 26). Quinolones (J01M) was the most commonly prescribed subgroup in Germany (23.2%), Hungary (32.2%) Slovakia (36.2%) and Spain (28.1%). 'Other antibacterials' (J01X) was the most common subgroup in Belgium (40.3%), Finland (30.1%), Lithuania (38.1%) and the Netherlands (42.2%). In Denmark, the most common subgroup was 'sulfonamides and trimethoprim' (J01E; 40.2%). In Greece and Italy, 'other beta-lactam antibacterials' (J01D) were the most frequently prescribed antibacterials for systemic use (30.9% and 31.5%, respectively).

'Other antibacterials' (J01X) was the most commonly prescribed subgroup for prophylaxis in 14 countries, although an equal number of 'other antibacterials' (J01X) and 'sulfonamides and trimethoprim' (J01E) prescriptions were reported by Portugal. 'Sulfonamides and trimethoprim' (J01E) were also predominantly prescribed for prophylaxis in Denmark and UK-Wales (Table 26).

The most frequently prescribed subgroup of antibacterials for systemic use for the treatment of HAIs in 18 countries was penicillins (38.0%). Quinolones (J01M) was the most frequently prescribed antibacterial subgroup for treatment of HAIs in Germany, Hungary, Slovakia and Spain. In Greece and Italy, 'other beta-lactam antibacterials' (J01D) were the most commonly prescribed in this indication (Table 27).

Figure 26. Distribution of use of antibacterials for systemic use (ATC J01), by country/administration, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample; No data for Cyprus and Czechia.*

Table 26. Distribution of antibacterials for systemic use (ATC J01) used for prophylaxis, by country/administration, HALT-3, 2016–2017

Country/Administration	All (J01)	Tetracyclines (J01A)		Amphenicols (J01B)		Penicillins (J01C)		Other beta-lactams (J01D)		Sulfonamides and trimethoprim (J01E)		Macrolides, lincosamides and strepto-gramins (J01F)		Amino-glycosides (J01G)		Quinolones (J01M)		Combinations of antibacterials (J01R)		Other antibacterials (J01X)**	
	n	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Austria*	6	0	0.0	0	0.0	1	16.7	1	16.7	1	16.7	3	50.0	0	0.0	0	0.0	0	0.0	0	0.0
Belgium	173	2	1.2	0	0.0	13	7.5	0	0.0	1	0.6	20	11.6	0	0.0	4	2.3	0	0.0	133	76.9
Croatia*	16	1	6.3	0	0.0	6	37.5	0	0.0	2	12.5	3	18.8	0	0.0	3	18.8	0	0.0	1	6.3
Denmark	228	0	0.0	0	0.0	33	14.5	0	0.0	137	60.1	3	1.3	0	0.0	2	0.9	0	0.0	53	23.2
Finland	244	5	2.0	0	0.0	27	11.1	9	3.7	83	34.0	2	0.8	0	0.0	2	0.8	1	0.4	115	47.1
France[a]	26	1	3.8	0	0.0	6	23.1	2	7.7	1	3.8	4	15.4	0	0.0	3	11.5	0	0.0	9	34.6
Germany	5	0	0.0	0	0.0	1	20.0	0	0.0	1	20.0	0	0.0	0	0.0	1	20.0	0	0.0	2	40.0
Greece*	4	0	0.0	0	0.0	1	25.0	1	25.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	50.0
Hungary	1	0	0.0	0	0.0	1	100	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Ireland	232	9	3.9	0	0.0	17	7.3	19	8.2	76	32.8	22	9.5	1	0.4	4	1.7	1	0.4	83	35.8
Italy	51	1	2.0	0	0.0	12	23.5	12	23.5	6	11.8	1	2.0	0	0.0	17	33.3	0	0.0	2	3.9
Lithuania	6	0	0.0	0	0.0	1	16.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	83.3
Luxembourg*	10	0	0.0	0	0.0	3	30.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	70.0
Malta*	5	0	0.0	0	0.0	3	60.0	0	0.0	0	0.0	1	20.0	0	0.0	1	20.0	0	0.0	0	0.0
Netherlands[a]	90	8	8.9	0	0.0	5	5.6	0	0.0	8	8.9	17	18.9	0	0.0	3	3.3	0	0.0	49	54.4
Norway[a]	23	0	0.0	0	0.0	0	0.0	0	0.0	3	13.0	0	0.0	0	0.0	0	0.0	0	0.0	20	87.0
Poland*	8	0	0.0	0	0.0	0	0.0	0	0.0	1	12.5	0	0.0	0	0.0	0	0.0	0	0.0	7	87.5
Portugal	42	0	0.0	0	0.0	8	19.0	2	4.8	13	31.0	3	7.1	0	0.0	3	7.1	0	0.0	13	31.0
Slovakia	25	0	0.0	0	0.0	4	16.0	4	16.0	1	4.0	2	8.0	0	0.0	14	56.0	0	0.0	0	0.0

Country/Administration	All (J01)	Tetracyclines (J01A)		Amphenicols (J01B)		Penicillins (J01C)		Other beta-lactams (J01D)		Sulfonamides and trimethoprim (J01E)		Macrolides, lincosamides and strepto-gramins (J01F)		Amino-glycosides (J01G)		Quinolones (J01M)		Combinations of antibacterials (J01R)		Other antibacterials (J01X)**	
	n	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Spain	86	0	0.0	0	0.0	17	19.8	8	9.3	15	17.4	16	18.6	0	0.0	14	16.3	0	0.0	16	18.6
Sweden[a]	36	0	0.0	0	0.0	7	19.4	0	0.0	5	13.9	1	2.8	0	0.0	0	0.0	0	0.0	23	63.9
UK-Northern Ireland	137	1	0.7	0	0.0	8	5.8	45	32.8	37	27.0	3	2.2	0	0.0	2	1.5	1	0.7	40	29.2
UK-Scotland	28	2	7.1	0	0.0	3	10.7	2	7.1	9	32.1	1	3.6	0	0.0	0	0.0	0	0.0	11	39.3
UK-Wales	40	0	0.0	0	0.0	5	12.5	10	25.0	17	42.5	1	2.5	0	0.0	0	0.0	0	0.0	7	17.5
Total	**1 522**	**30**	**2.0**	**0**	**0.0**	**182**	**12.0**	**115**	**7.6**	**417**	**27.4**	**103**	**6.8**	**1**	**0.1**	**73**	**4.8**	**3**	**0.2**	**598**	**39.3**
North Macedonia*	1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	100	0	0.0	0	0.0
Serbia*	8	0	0.0	0	0.0	0	0.0	2	25.0	1	12.5	1	12.5	0	0.0	4	50.0	0	0.0	0	0.0

** Poor or very poor national representativeness of the LTCF sample; ** 22.5% of J01X was methenamine (J01XX05) and was used in Denmark (18.9% of the J01X use for prophylaxis), Finland (81.7%), Ireland (2.4%), Norway (95.0%) and Sweden (43.4%); [a] Data extracted from national surveys (see Section 2, 'Methodology'); No data for Cyprus and Czechia.*

Table 27. Distribution of antibacterials for systemic use (ATC J01) used for treatment, by country/administration, HALT-3, 2016–2017

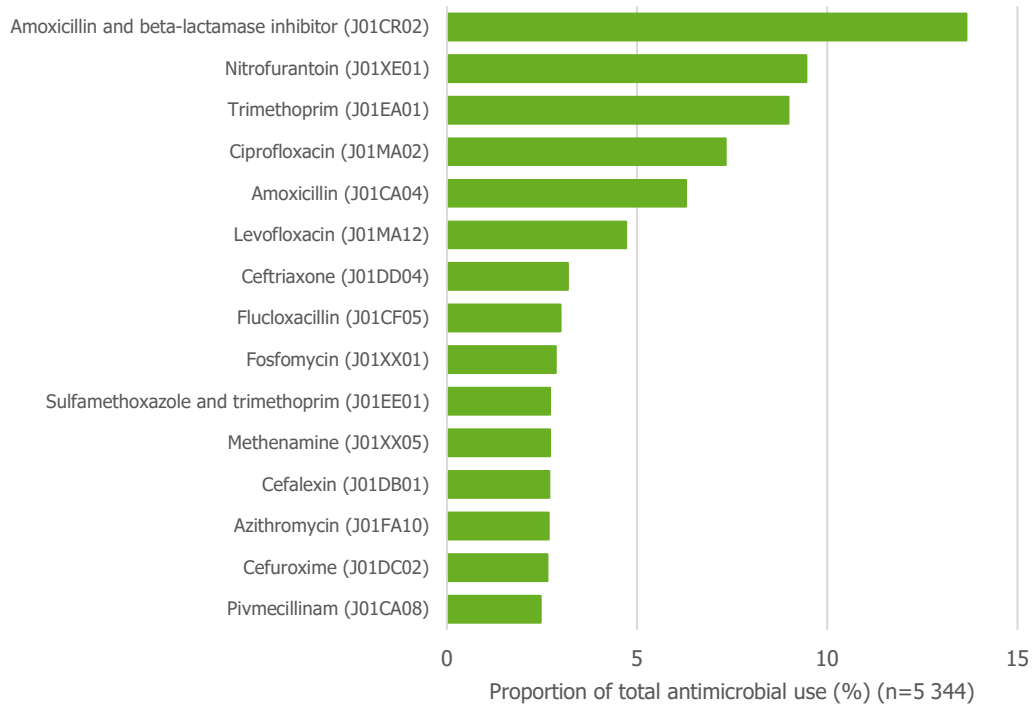
Country/Administration	All (J01)	Tetracyclines (J01A)		Amphenicols (J01B)		Penicillins (J01C)		Other beta-lactams (J01D)		Sulfonamides and trimethoprim (J01E)		Macrolides, lincosamides and strepto-gramins (J01F)		Amino-glycosides (J01G)		Quinolones (J01M)		Combinations of antibacterials (J01R)		Other antibacterials (J01X)	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Austria*	61	1	1.6	0	0.0	26	42.6	6	9.8	7	11.5	4	6.6	0	0.0	14	23.0	0	0.0	3	4.9
Belgium	298	7	2.3	1	0.3	113	37.9	9	3.0	9	3.0	30	10.1	1	0.3	70	23.5	0	0.0	58	19.5
Croatia*	15	0	0.0	0	0.0	9	60.0	2	13.3	0	0.0	1	6.7	0	0.0	2	13.3	0	0.0	1	6.7
Denmark	128	0	0.0	0	0.0	101	78.9	1	0.8	6	4.7	4	3.1	0	0.0	12	9.4	0	0.0	4	3.1
Finland	145	5	3.4	0	0.0	50	34.5	43	29.7	13	9.0	3	2.1	0	0.0	29	20.0	0	0.0	2	1.4
France[a]	162	0	0.0	0	0.0	57	35.2	37	22.8	6	3.7	18	11.1	0	0.0	25	15.4	1	0.6	18	11.1
Germany	77	6	7.8	0	0.0	15	19.5	13	16.9	12	15.6	5	6.5	0	0.0	18	23.4	0	0.0	8	10.4
Greece*	51	0	0.0	0	0.0	13	25.5	16	31.4	1	2.0	7	13.7	0	0.0	12	23.5	0	0.0	2	3.9
Hungary	64	1	1.6	0	0.0	19	29.7	9	14.1	8	12.5	5	7.8	0	0.0	21	32.8	0	0.0	1	1.6
Ireland	311	7	2.3	1	0.3	166	53.4	33	10.6	25	8.0	37	11.9	0	0.0	23	7.4	0	0.0	19	6.1
Italy	463	0	0.0	0	0.0	125	27.0	150	32.4	14	3.0	19	4.1	9	1.9	113	24.4	0	0.0	33	7.1
Lithuania	15	0	0.0	0	0.0	6	40.0	0	0.0	0	0.0	1	6.7	0	0.0	5	33.3	0	0.0	3	20.0
Luxembourg*	27	0	0.0	0	0.0	9	33.3	3	11.1	2	7.4	1	3.7	0	0.0	8	29.6	0	0.0	4	14.8
Malta*	87	1	1.1	0	0.0	42	48.3	3	3.4	3	3.4	15	17.2	0	0.0	15	17.2	2	2.3	6	6.9
Netherlands[a]	116	4	3.4	0	0.0	46	39.7	0	0.0	5	4.3	6	5.2	0	0.0	17	14.7	0	0.0	38	32.8
Norway[a]	106	5	4.7	0	0.0	48	45.3	9	8.5	18	17.0	1	0.9	1	0.9	7	6.6	0	0.0	17	16.0
Poland*	65	1	1.5	0	0.0	20	30.8	16	24.6	2	3.1	3	4.6	5	7.7	12	18.5	0	0.0	6	9.2
Portugal	180	1	0.6	0	0.0	65	36.1	25	13.9	23	12.8	13	7.2	2	1.1	33	18.3	0	0.0	18	10.0
Slovakia	91	4	4.4	0	0.0	21	23.1	16	17.6	7	7.7	11	12.1	2	2.2	28	30.8	1	1.1	1	1.1

Country/Administration	All (J01)	Tetracyclines (J01A)		Amphenicols (J01B)		Penicillins (J01C)		Other beta-lactams (J01D)		Sulfonamides and trimethoprim (J01E)		Macrolides, lincosamides and strepto-gramins (J01F)		Amino-glycosides (J01G)		Quinolones (J01M)		Combinations of antibacterials (J01R)		Other antibacterials (J01X)	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Spain	675	2	0.3	0	0.0	189	28.0	116	17.2	37	5.5	55	8.1	13	1.9	200	29.6	2	0.3	61	9.0
Sweden[a]	79	6	7.6	0	0.0	49	62.0	1	1.3	1	1.3	5	6.3	0	0.0	8	10.1	0	0.0	9	11.4
UK-Northern Ireland	136	10	7.4	0	0.0	66	48.5	13	9.6	22	16.2	8	5.9	0	0.0	4	2.9	0	0.0	13	9.6
UK-Scotland	101	11	10.9	0	0.0	50	49.5	1	1.0	17	16.8	8	7.9	0	0.0	1	1.0	0	0.0	13	12.9
UK-Wales	59	3	5.1	0	0.0	28	47.5	2	3.4	15	25.4	6	10.2	0	0.0	2	3.4	0	0.0	3	5.1
Total	**3 512**	**75**	**2.1**	**2**	**0.1**	**1 333**	**38.0**	**524**	**14.9**	**253**	**7.2**	**266**	**7.6**	**33**	**0.9**	**679**	**19.3**	**6**	**0.2**	**341**	**9.7**
North Macedonia	30	0	0.0	0	0.0	6	20.0	11	36.7	0	0.0	2	6.7	3	10.0	6	20.0	0	0.0	2	6.7
Serbia*	51	1	2.0	0	0.0	7	13.7	11	21.6	1	2.0	3	5.9	10	19.6	14	27.5	0	0.0	4	7.8

** Poor or very poor national representativeness of the LTCF sample; [a] Data extracted from national surveys (see Section 2, 'Methodology'); No data for Cyprus and Czechia.*

Fifteen antimicrobial agents accounted for over 75% of the total antimicrobial use in the participating LTCFs (n=4 028/5 344 antimicrobial agents; Figure 27). The most frequently prescribed antimicrobial agent, 'amoxicillin and beta-lactamase inhibitor' (J01CR02; 13.7%), was used in all countries except Norway. The next most frequently prescribed antimicrobial agents were nitrofurantoin (J01XE01; 9.5%) and trimethoprim (J01EA01; 9.0%).

Figure 27. The most frequently reported antimicrobial agents, accounting for >75% of total antimicrobial use in participating LTCFs, HALT-3, 2016–2017

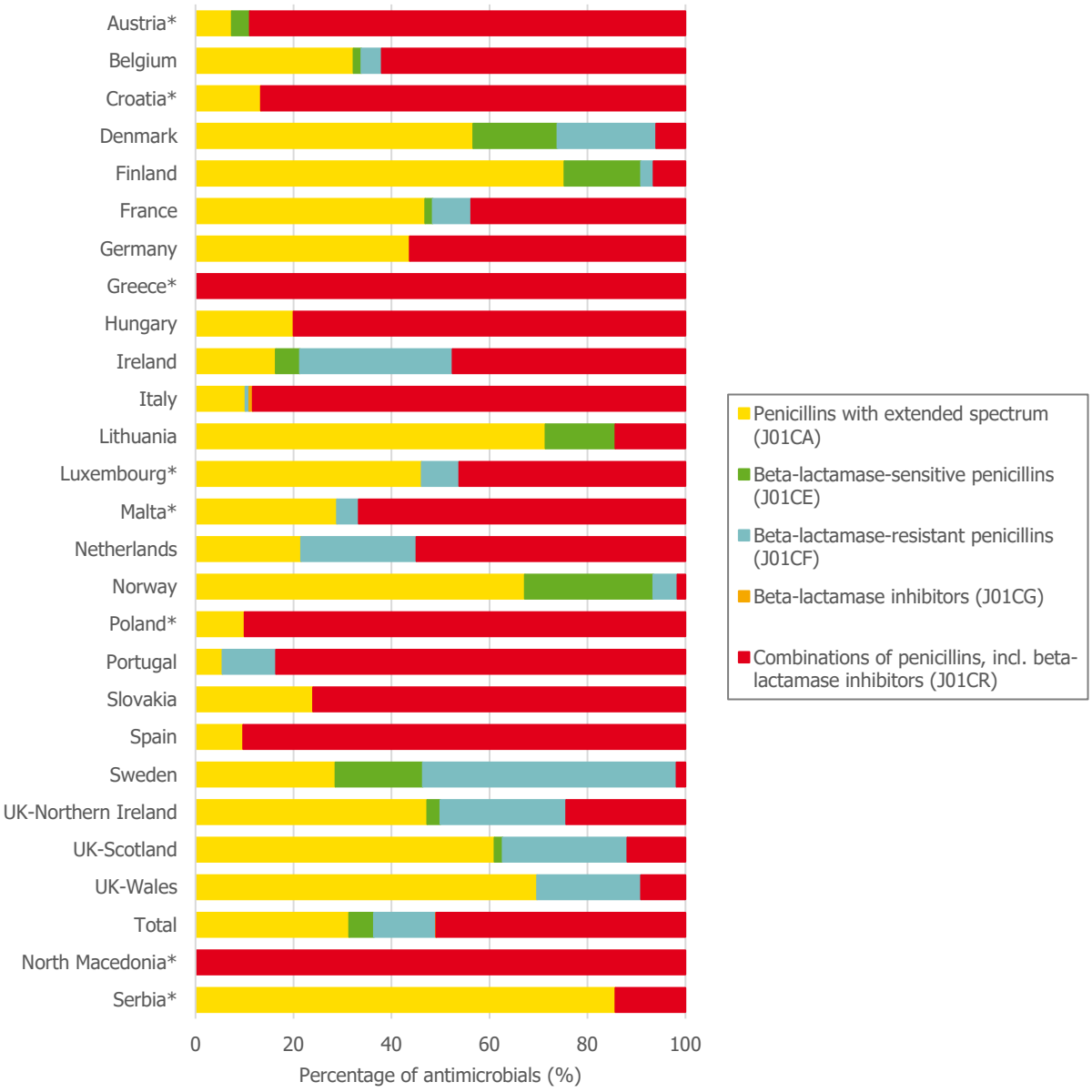


Penicillins (ATC J01C)

Within penicillins (ATC J01C; n=1 531, ATC level 4 data missing for seven antimicrobial agents), the most frequently prescribed subgroup was 'combinations of penicillins, including beta-lactamase inhibitors' (J01CR; 50.9%), followed by 'penicillins with extended spectrum' (J01CA; 31.4%) and 'beta-lactamase-resistant penicillins' (J01CF; 12.6%). 'Beta-lactamase-sensitive penicillins' (J01CE; 5.1%) and 'beta-lactamase inhibitors' (J01CG; 0.1%) were less common. The distribution of penicillin use into these subgroups is presented by country/administration in Figure 28.

J01C antibacterial agents were predominantly prescribed for treatment of infections (86.7%). These were mostly for the treatment of RTIs (47.5%), UTIs (22.0%) and skin or wound infections (20.8%). Prophylactic use (11.8%) was mainly for the prevention of UTIs (37.9%), skin or wound infections (24.7%) and RTIs (18.7%). The indication for the prescription was not available for 23/1 531 (1.5%) of the reported prescriptions of penicillins (J01C).

Figure 28. Distribution of the use of penicillins (ATC J01C), by subgroups and country/administration, HALT-3, 2016–2017



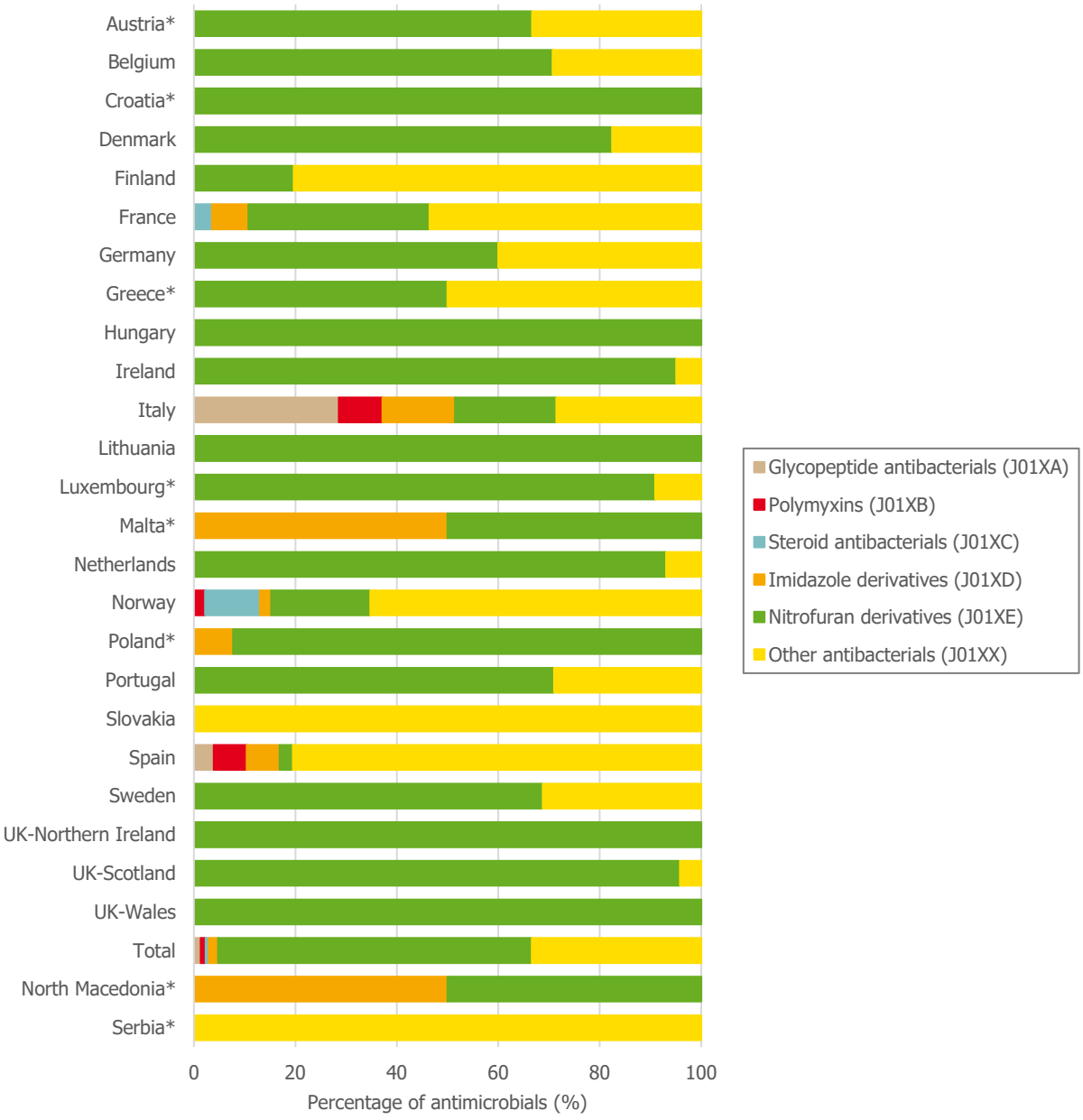
** Poor or very poor national representativeness of the LTCF sample; No data for Cyprus and Czechia.*

Other antibacterials (ATC J01X)

Within the group of 'other antibacterials' (J01X; n=949), the most frequently used subgroups were nitrofuran derivatives (J01XE; 61.9%) and 'other antibacterials' (J01XX; 33.4%). Prescriptions of imidazole derivatives (J01XD; 1.8%), glycopeptide antibacterials (J01XA; 1.4%), polymyxins (J01XB; 1.0%) and steroid antibacterials (J01XC; 0.6%) were relatively rare. Figure 29 shows the distribution of use by subgroups and country/administration.

'Other antibacterials' (J01X) were predominantly prescribed for prophylaxis (n=598; 63.0%), almost exclusively for the prevention of UTIs (98.7%). Most of the therapeutic use of 'other antibacterials' (J01X) was for the treatment of UTIs (85.3%; n=291/341), with fewer prescriptions for skin or wound infections (4.1%; n=14/341). The indication was missing for 10 (1.1%) prescriptions of 'other antibacterials' (J01X).

Figure 29. Distribution of the use of 'other antibacterials' (ATC J01X), by subgroups and country/administration, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample; No data for Cyprus and Czechia.*

Quinolone antibacterials (ATC J01M)

All the quinolone antibacterials (J01M; n=759) prescribed in the participating countries/administrations were fluoroquinolones (J01MA). The most commonly prescribed fluoroquinolones were ciprofloxacin (J01MA02; 51.7%) and levofloxacin (J01MA12; 33.2%).

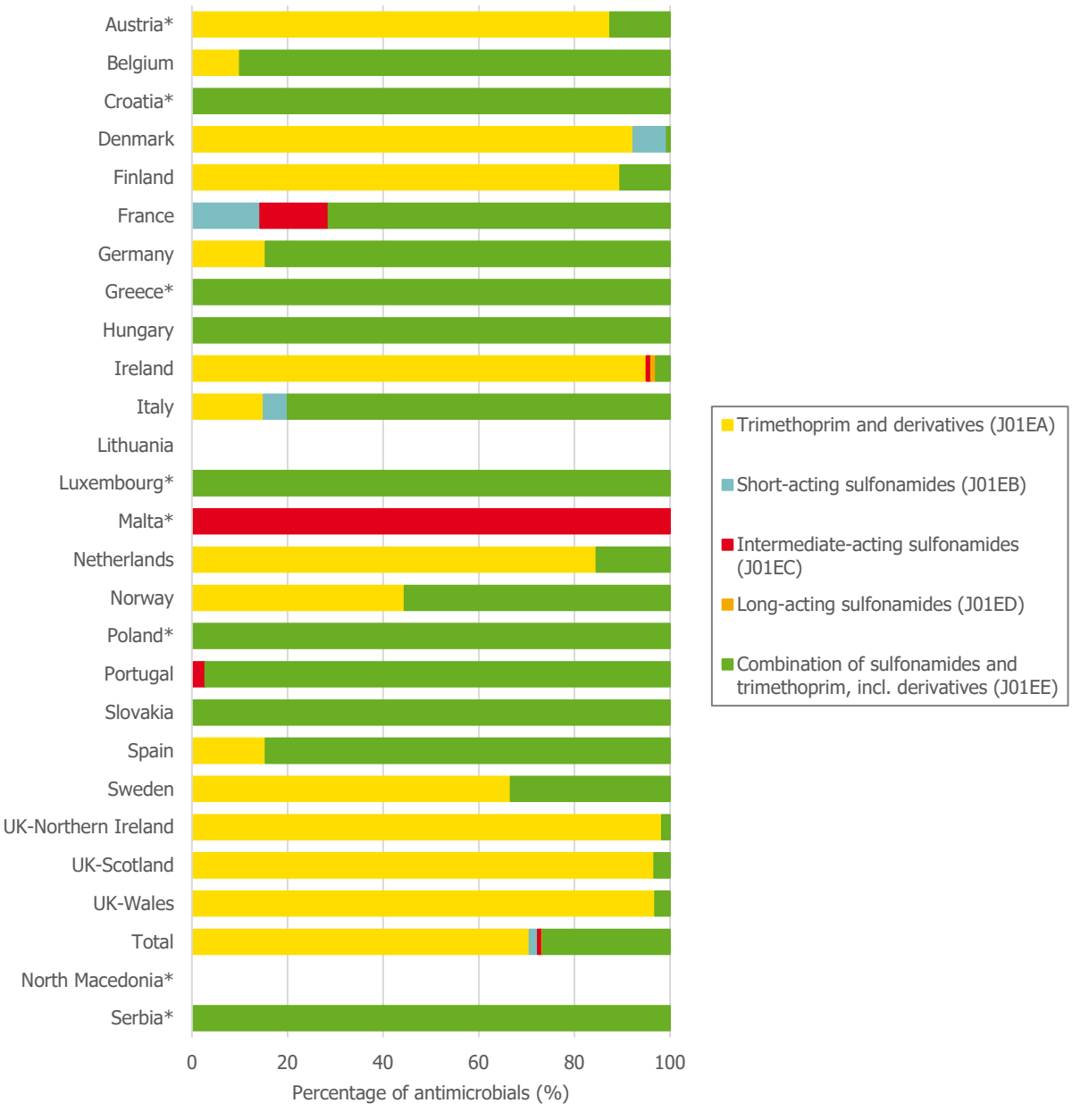
The most frequent indications for treatment with quinolones (n=679; 89.5% of the total quinolone prescriptions) were UTIs (40.8%), RTIs (37.9%) and skin or wound infections (12.2%). Prophylactic use of quinolones (9.6% of the total quinolone prescriptions) was mainly for UTIs (56.2%; n=41/73) and RTIs (12.3%; n=9/73). The indication for use was missing for seven quinolone prescriptions.

Sulfonamides and trimethoprim (ATC J01E)

The most frequently prescribed sulfonamides and trimethoprim (J01E; n=680) were trimethoprim and derivatives (J01EA; 70.6%) and combinations of sulfonamides and trimethoprim, including derivatives (J01EE; 26.6%). Only five countries (Denmark, France, Ireland, Malta and Portugal) used short-acting sulfonamides (J01EB), intermediate-acting sulfonamides (J01EC) and long-acting sulfonamides (J01ED; Figure 30).

The majority of 'sufonamides and trimethoprim' (J01E) were prescribed for prophylaxis (61.3%) rather than treatment (37.2%. The indication was missing for n=10 (1.5%) prescriptions. Prophylactic use was mainly for the prevention of UTIs (89.5%), RTIs (3.6%) or 'other infections' (3.4%). Treatment was mainly for UTIs (77.5%), but also for RTIs (8.3%), skin or wound infections (6.3%) or 'other infections' (2.8%).

Figure 30. Distribution of the use of 'sulfonamides and trimethoprim' (ATC J01E), by subgroups and country/administration, HALT-3, 2016–2017



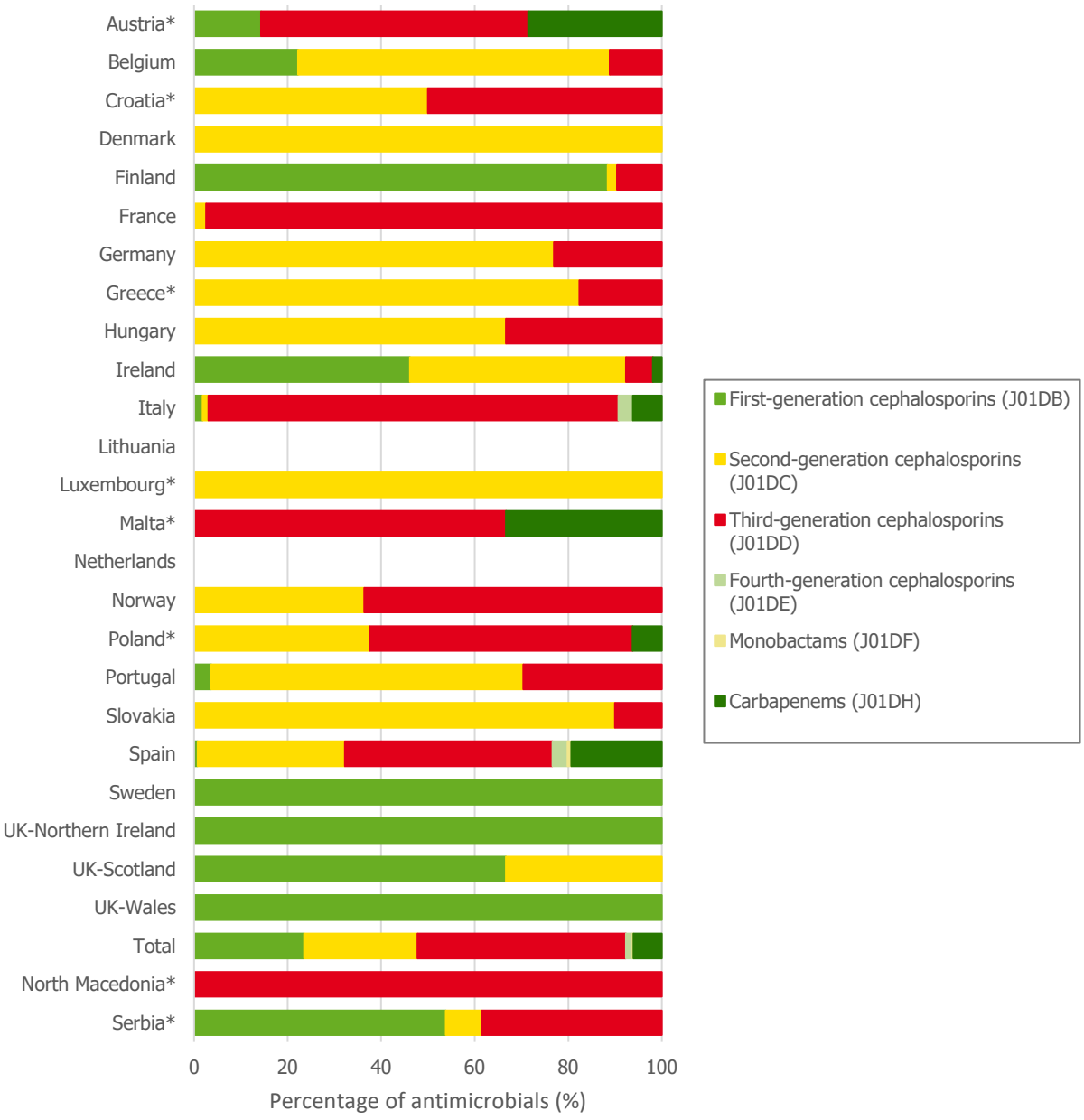
** Poor or very poor national representativeness of the LTCF sample; No data for Cyprus and Czechia.*

Other beta-lactams (ATC J01D)

The most commonly prescribed 'other beta-lactams' (J01D; n=641) were third-generation cephalosporins (J01DD; 44.6%), second-generation cephalosporins (J01DC; 24.2%) and first-generation cephalosporins (J01DB; 23.6%). There were fewer reported prescriptions of carbapenems (J01DH; 6.1%) and fourth-generation cephalosporins (J01DE; 1.4%). Only one prescription of monobactam (J01DF) was reported (0.2%; Figure 31). The percentage of carbapenem use varied from 0% in 18 countries, to less than 15% in Ireland, Italy and Poland, to more than 15% in Austria, Malta and Spain.

'Other beta-lactams' were predominantly prescribed for treatment of infections (81.8%); for RTIs (43.9%), UTIs (34.2%) and skin or wound infections (11.5%). Prophylactic use (17.9%) was mainly for the prevention of UTIs (72.2%) or RTIs (15.7%). The indication was not recorded for two (0.3%) prescriptions of 'other beta-lactams' (J01D).

Figure 31. Distribution of the use of 'other beta-lactams' (ATC J01D), by subgroups and country/administration, HALT-3, 2016–2017



** Poor or very poor national representativeness of the LTCF sample; No data for Cyprus and Czechia.*

LTCF risk adjustment model for antimicrobial use

Characteristics of LTCFs and LTCF populations that are known to be associated with the prevalence of antimicrobial use were included in a multivariable linear regression model (Table 28). The model indicated that characteristics of LTCFs and LTCF residents only explained 21% of the variance in antimicrobial use (R^2=0.21).

Higher prevalence of antimicrobial use was associated with mixed LTCFs and LTCFs with fewer than 57 beds. Additionally, a 1% increase in the proportion of male residents was associated with an 8% increase in the prevalence of antimicrobial use. Similarly, a 1% increase in the proportion of residents over 85 years of age was associated with a 5% increase in the prevalence of antimicrobial use.

Prevalence of antimicrobial use was also associated with the proportion of residents with a vascular catheter, the proportion of residents with surgery in the previous 30 days and other wounds, and wheelchair-user or bedridden residents. A 1% increase in the proportion of selected risk factors increased prevalence by 23% for vascular catheter, 18% for previous surgery and 11% for other wounds, respectively.

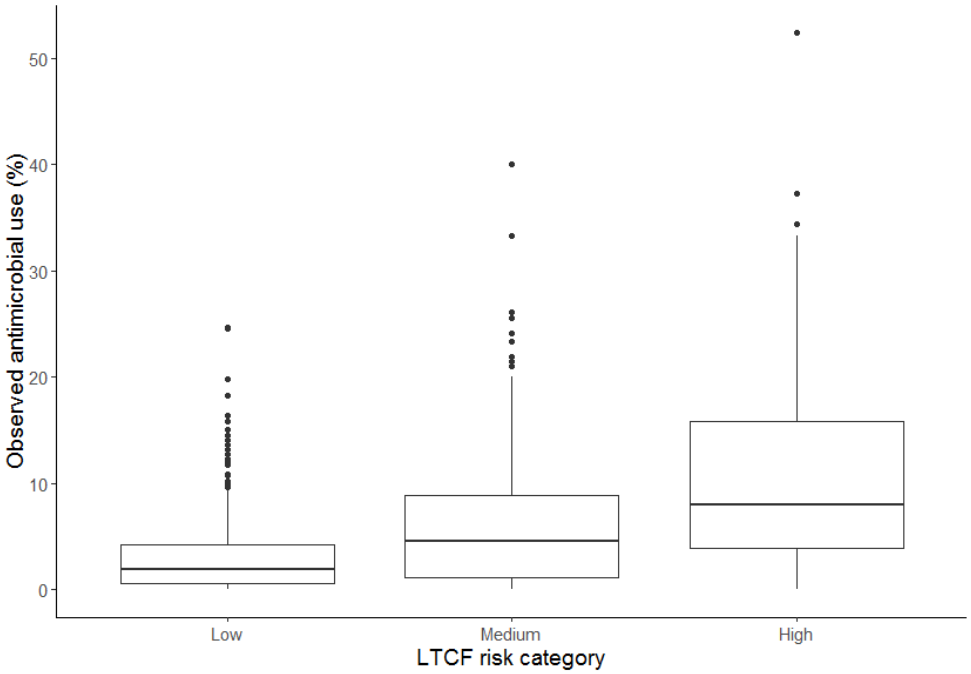
Table 28. Multivariable linear regression analysis of the association between the characteristics of LTCFs and LTCF residents and the prevalence of antimicrobial use*, 20 countries/administrations, 2016–2017**

Characteristics	Coefficient (95% confidence interval)	p-value
Type of LTCF		
Residential home	Ref.	-
General nursing home	0.40 (-0.50–1.31)	0.384
Mixed	1.70 (0.67–2.73)	**0.001**
Size of LTCF		
>95 beds	Ref.	-
57–95 beds	1.04 (0.06–2.03)	**0.038**
35–56 beds	2.63 (1.61–3.65)	**<0.001**
<35 beds	3.38 (2.38–4.39)	**<0.001**
Characteristics of LTCF residents		
Aged over 85 years (%)	0.05 (0.03–0.08)	**<0.001**
Male (%)	0.08 (0.05–0.11)	**<0.001**
Wheelchair-user or bedridden (%)	-0.04 (-0.06–-0.02)	**<0.001**
Disoriented in time and/or space (%)	0.00 (-0.01–0.02)	0.657
Urinary and/or faecal incontinence (%)	0.02 (-0.00–0.04)	0.064
Pressure sore (%)	-0.01 (-0.07–0.05)	0.767
Other wound (%)	0.11 (0.07–0.16)	**<0.001**
Surgery in the previous 30 days (%)	0.18 (0.08–0.28)	**<0.001**
Urinary catheter (%)	0.04 (-0.00–0.08)	0.072
Vascular catheter (%)	0.23 (0.15–0.30)	**<0.001**

** Prevalence of residents who received at least one antimicrobial agent on the day of the survey; ** France, Norway, Portugal and Sweden were excluded from the multivariable analysis (see Section 2, 'Methodology').*

Following the classification of the LTCFs to low-, medium- and high-risk LTCFs, the median percentage of residents receiving at least one antimicrobial agent on the day of the survey was 2.0% (interquartile range (IQR): 0.6–4.2%) in the low-risk LTCFs (n=295), 4.5% (IQR: 1.1–8.9%) in the medium-risk LTCFs (n=587), and 8.0% (IQR: 3.8–15.9%) in the high-risk LTCFs (n=295; Figure 32).

Figure 32. Percentage of residents receiving at least one antimicrobial agent on the day of the survey, by LTCF risk category estimated by multivariable linear regression analysis, HALT-3, 2016–2017



3.2.8 Validation study

Ten countries/administrations recruited 17 LTCFs to participate in the validation study. These were Austria (n=1 LTCF), Finland (n=1), Ireland (n=1), Italy (n=1), the Netherlands (n=4), Portugal (n=1), Spain (n=2), UK-Northern Ireland (n=2), UK-Scotland (n=2) and Serbia (n=2). These 17 LTCFs collected data from 953 residents. As the Netherlands did not collect institutional data in the primary survey, the validation study included institutional data from only 13/17 LTCFs in nine countries.

The sensitivity of data on HAIs and antimicrobial use is presented in Table 29. The sensitivity of the data on antimicrobial use was relatively high (87.1%), but lower for HAIs (78.7%). The specificity for HAIs and antimicrobial use was nearly 100% as there were only a few false positive detections. There was full agreement between the primary team and the validation team with regards to the presence of infection at (re)admission to the LTCF, the date of onset, and the origin of the HAI.

Application of the positive predictive value (PPV; 80.4%; 95% CI: 66.1–90.6%) and negative predictive value (NPV; 98.9%; 95% CI: 98.8–99.0%) for HAIs to the total EU/EEA database resulted in an estimated sensitivity of 73.7% and a specificity of 99.2%. Similarly, applying the PPV (88.4%; 95% CI: 87.5–89.3%) and NPV (98.9%; 95% CI: 98.8–99.0%) for antimicrobial use resulted in a sensitivity of 80.6% and a specificity of 99.4%.

The agreement between the primary team and the validation team during validation of the institution-level performance indicators was classified as 'strong' (kappa = 81.6%; 95% CI: 67.7–95.4%).

Table 29. Sensitivity and specificity of data on HAIs, antimicrobial use and institutional-level performance indicators in countries/administrations that participated in the validation study, HALT-3, 2016–2017

	Sensitivity % (95% CI)	Specificity % (95% CI)
Validation study results of the validation study sample		
Institution-level performance indicators[a]	89.7 (82.6–94.5)	92.8 (84.9–97.3)
HAIs[b]	78.7 (64.3–89.3)	99.0 (98.1–99.5)
Antimicrobial use[b]	87.1 (77.0–94.0)	99.1 (98.2–99.6)
Validation study results applied to the entire EU/EEA database		
HAIs	73.7 (72.3–75.1)	99.2 (99.2–99.3)
Antimicrobial use	80.6 (79.6–81.7)	99.4 (99.3–99.4)

95% CI: 95% confidence interval; [a] n=9 countries; [b] n=10 countries.

3.2.9 National denominators and burden estimates of HAIs in LTCFs in European countries/administrations

Table 30 presents the denominator data for the LTCF categories presented in the previous sections, i.e. general nursing homes, residential homes and mixed LTCFs.

Twenty-four countries/administrations provided an update to the denominator data that they had previously reported for the HALT-2 (2013) or HALT (2010) surveys. Seven countries did not provide this update, so calculations for HALT-3 assumed that their denominators from previous surveys remained unchanged (Table 30). These denominator data indicate that there were at least 62 471 LTCFs for older adults in the EU Member States, Iceland and Norway in 2016–2017 with a capacity of approximately 3 486 967 beds.

In HALT-3, the crude prevalence of residents with at least one HAI was 3.7% (country range 0.9–8.5%) while the country-weighted validation-corrected HAI prevalence in LTCFs in participating countries was estimated to be 3.9% (95% cCI: 2.4–6.0%). On any given day, the total number of residents with at least one HAI in LTCFs in the EU/EEA in 2016–2017 was estimated at 129 940 residents (95% cCI: 79 570–197 625187 692). The total annual number of HAIs in LTCFs in the EU/EEA was estimated at 4.4 million (95% cCI: 2.0–8.0 million).

Table 30. Number of LTCFs and LTCF beds in general nursing homes, residential homes and mixed LTCFs, by country/administration, HALT-3, 2016–2017

Country/ Administration	Data source	General nursing homes		Residential homes		Mixed LTCFs		Total		% of country population ≥ 80 years**
		N of LTCFs	N of beds	N of LTCFs	N of beds	N of LTCFs	N of beds	N of LTCFs	N of beds	
Austria	HALT	NA	NA	NA	NA	817	72 602	817	72 602	4.9
Belgium	HALT-3	1 230	132 463	329	13 999	NA	NA	1 559	146 462	5.5
Bulgaria	HALT	NA	NA	NA	NA	33	486	33	486	4.8
Croatia	HALT-3	155	18 676	170	18 573	ND	ND	325	37 249	5.0
Cyprus	HALT-3	ND	ND	43	1 384	47	2 052	90	3 436	3.4
Czechia	HALT-2	73	7 204	ND	ND	ND	ND	73	17 204	4.0
Denmark*	HALT-3	*	*	*	*	827	42 668	827	42 668	4.3
Estonia	HALT-3	59	1 849	NA	NA	NA	NA	59	1 849	5.3
Finland	HALT-3	350	8 212	1 578	42 161	NA	NA	1 928	50 373	5.2
France	HALT-3	7 428	577 436	2 316	110 500	NA	NA	9 744	687 936	5.9
Germany*	HALT-3	*	*	*	*	10 389	852 849	10 389	852 849	6.0
Greece	HALT-3	NA	NA	NA	NA	263	10 849	263	10 849	6.7
Hungary	HALT-2	1 067	55 918	110	2 011	ND	ND	1 177	57 929	4.3
Iceland	- -	ND	ND	ND	ND	ND	ND	43	ND	3.6
Ireland*	HALT-3	*	*	NA	NA	578	30 531	578	30 531	3.2
Italy	HALT-3	3 219	186 872	NA	NA	ND	ND	3 219	186 872	6.8
Latvia	HALT-2	NA	NA	NA	NA	82	5 798	82	5 798	5.2
Lithuania*	HALT-3	*	*	*	*	154	11 722	154	11 722	5.5
Luxembourg	HALT-3	51	6 250	11	716	NA	NA	62	6 966	3.9
Malta	HALT-3	NA	NA	35	3 133	6	1 902	41	5 035	4.1

Country/ Administration	Data source	General nursing homes		Residential homes		Mixed LTCFs		Total		% of country population ≥ 80 years**
		N of LTCFs	N of beds	N of LTCFs	N of beds	N of LTCFs	N of beds	N of LTCFs	N of beds	
Netherlands	HALT-3	NA	NA	NA	NA	700	92 000	700	92 000	4.5
Norway*	HALT-3	*	*	*	*	907	39 583	907	39 583	4.2
Poland	HALT-3	257	12 745	116	4 546	NA	NA	373	17 291	4.2
Portugal*	HALT-3	*	*	*	*	*	*	360	8 400	6.1
Romania	HALT-3	ND	ND	ND	ND	ND	ND	628	ND	4.4
Slovakia	HALT-3	99	1 430	300	12 974	278	13 093	677	27 497	3.2
Slovenia	HALT-2	NA	NA	NA	NA	90	20 777	90	20 777	5.1
Spain*	HALT-3	*	*	*	*	5 387	372 306	5 387	372 306	6.2
Sweden*	HALT-3	*	*	*	*	2 300	93 000	2 300	93 000	5.1
UK-England	HALT-2	4 684	220 048	12 789	248 610	ND	ND	17 473	468 658	4.9
UK-Northern Ireland	HALT-3	NA	NA	195	4 195	250	11 729	445	15 924	
UK-Scotland*	HALT-3	*	*	*	*	873	37 746	873	37 746	
UK-Wales	HALT-3	269	11 565	526	13 081	ND	ND	795	24 646	
Total	**NA**	**26 674**	**1 858 811**	**16 940**	**476 222**	**16 159**	**858 844**	**62 471**	**3 440 071**	**5.5*** **

*NA: not applicable, i.e. type of LTCF is not present in the country; ND: no data; * Country unable to make a distinction between types of LTCF; ** Source: Eurostat, 2017; *** EU/EEA including Liechtenstein; N: number.*

3.3 Results of the specialised LTCFs

Fourteen countries provided data for the specialised LTCF types which were not included in the data presented in previous chapters (n=435 LTCFs; Table 31). In total, 14 837 eligible residents were included. The two most frequently reported types of specialised LTCF were, 'LTCFs for mentally disabled persons' (n=178 LTCFs) with 4 978 eligible residents, and 'Rehabilitation centres' (n=156 LTCFs) with 4 482 eligible residents (Table 31). No country recruited sanatoria (Table 3).

Table 31 provides an overview of the differences between these specialised types of LTCF, including the demographics, care load indicators and risk factors for HAIs and antimicrobial use related to their residents.

Table 31. Distribution of demographics, risk factors and care load indicators in the resident populations of specialised LTCFs, by type of LTCF, HALT-3, 2016–2017

Type of LTCF	N of LTCFs	N of eligible residents	Median %									
			Residents older than 85 years	Male residents	Residents with a urinary catheter	Residents with a vascular catheter	Residents with pressure sores	Residents with other wounds	Residents with recent surgery	Residents with incontinence (for urine and/or faeces)	Residents with disorientation (in time and/or space)	Residents with impaired mobility (wheelchair-user or bedridden)
LTCFs for mentally disabled persons	178	4 978	37.5	37.5	0.0	0.0	0.0	2.3	0.0	64.2	87.5	33.3
Rehabilitation centres	156	4 482	20.0	43.8	9.1	0.0	10.4	14.3	0.7	50.0	38.5	61.7
Psychiatric LTCFs	41	1 891	0.9	55.0	0.8	0.0	0.0	0.0	0.0	41.2	23.1	18.4
Palliative care centres	26	366	14.3	46.7	27.3	11.1	18.2	18.8	0.0	63.6	50.0	85.2
LTCFs for physically disabled persons	3	57	0.0	38.5	7.7	0.0	2.8	2.8	0.0	75.0	62.5	76.9
Other LTCFs	31	3 063	4.4	41.6	1.0	0.0	0.0	1.6	0.4	45.5	47.4	23.1
Total	**435**	**14 837**	**22.0**	**41.6**	**5.6**	**0.0**	**1.8**	**7.5**	**0.0**	**55.6**	**51.4**	**43.0**

There were 516 residents with at least one HAI on the day of the survey in specialised LTCFs (crude percentage: 3.5%). There were 525 HAIs recorded. The majority of these HAIs were associated with the current LTCF (71.4%), while 19.4% were associated with a hospital, and 1.5% were associated with another LTCF. The origin of the HAI was unknown for 7.6% of the HAIs. The most frequently reported HAIs associated with a hospital stay (n=102) were UTIs (32.4%), skin or wound infections (25.5%), RTIs (13.7%) and SSIs (9.8%). Table 32 gives an overview of the most common HAIs associated with the current LTCF, split by the type of specialised LTCF. The HAIs were mainly RTIs (36.5%), UTIs (26.9%) and skin or wound infections (22.1%).

The median HAI prevalence was 0.0% overall and ranged from 0.0% in LTCFs for mentally disabled persons and psychiatric LTCFs, to 12.5% in LTCFs for physically disabled persons (Table 31).

Table 32. Distribution of types of HAI associated with the current LTCF (number and relative frequency) in specialised LTCFs, by types of LTCF, HALT-3, 2016–2017

Type of HAI	LTCFs for mentally disabled persons		Rehabilitation centres		Psychiatric LTCFs		Palliative care centres		LTCFs for physically disabled persons		Other LTCFs		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
All types of HAI	**87**	**100**	**188**	**100**	**31**	**100**	**34**	**100**	**4**	**100**	**31**	**100**	**375**	**100**
Urinary tract infection (UTI)	22	25.3	57	30.3	9	29.0	6	17.6	0	0.0	7	22.6	101	26.9
Confirmed UTI	5	5.7	34	18.1	4	12.9	4	11.8	0	0.0	2	6.5	49	13.1
Probable UTI	17	19.5	23	12.2	5	16.1	2	5.9	0	0.0	5	16.1	52	13.9
Respiratory tract infections (RTIs)	34	39.1	73	38.8	11	35.5	7	20.6	1	25.0	11	35.5	137	36.5
Common cold/pharyngitis	19	21.8	29	15.4	2	6.5	0	0.0	0	0.0	5	16.1	55	14.7
'Flu'*	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0	1	0.3
Pneumonia	5	5.7	11	5.9	1	3.2	1	2.9	0	0.0	0	0.0	18	4.8
Other lower RTI	10	11.5	32	17.0	8	25.8	6	17.6	1	25.0	6	19.4	63	16.8
Skin infections	22	25.3	32	17.0	7	22.6	7	20.6	2	50.0	13	41.9	83	22.1
Cellulitis/soft tissue/wound infection	17	19.5	26	13.8	7	22.6	5	14.7	1	25.0	9	29.0	65	17.3
Herpes simplex or zoster infection	1	1.1	2	1.1	0	0.0	0	0.0	0	0.0	0	0.0	3	0.8
Fungal infection	3	3.4	3	1.6	0	0.0	2	5.9	1	25.0	4	12.9	13	3.5
Scabies	1	1.1	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0	2	0.5
Eye, ear, nose and mouth infection	5	5.7	11	5.9	3	9.7	12	35.3	1	25.0	0	0.0	32	8.5
Conjunctivitis	1	1.1	4	2.1	3	9.7	1	2.9	1	25.0	0	0.0	10	2.7
Ear infection	4	4.6	5	2.7	0	0.0	0	0.0	0	0.0	0	0.0	9	2.4
Sinusitis	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0	1	0.3
Oral candidiasis	0	0.0	1	0.5	0	0.0	11	32.4	0	0.0	0	0.0	12	3.2

Type of HAI	LTCFs for mentally disabled persons		Rehabilitation centres		Psychiatric LTCFs		Palliative care centres		LTCFs for physically disabled persons		Other LTCFs		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Gastrointestinal infection	2	2.3	7	3.7	1	3.2	0	0.0	0	0.0	0	0.0	10	2.7
Gastroenteritis	0	0.0	4	2.1	1	3.2	0	0.0	0	0.0	0	0.0	5	1.3
Clostridioides difficile infection	2	2.3	3	1.6	0	0.0	0	0.0	0	0.0	0	0.0	5	1.3
Surgical site infection (SSI)	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0	1	0.3
Superficial SSI	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0	1	0.3
Deep SSI	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Organ/space SSI	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Bloodstream infection	0	0.0	1	0.5	0	0.0	1	2.9	0	0.0	0	0.0	2	0.5
Unexplained fever	1	1.1	2	1.1	0	0.0	0	0.0	0	0.0	0	0.0	3	0.8
Other infection	1	1.1	4	2.1	0	0.0	1	2.9	0	0.0	0	0.0	6	1.6

** In HALT-3, 'flu' was defined as fever: a) single >37.8 °C oral/tympanic membrane OR b) repeated >37.2 °C oral OR >37.5 °C rectal OR c) >1.1 °C above baseline from any site – and at least three of the following symptoms: chills, new headache or eye pain, myalgia or body aches, malaise or loss of appetite, sore throat, or new/increased dry cough.*

Table 33. Number and prevalence of LTCF residents with at least one HAI or at least one antimicrobial agent in specialised LTCFs, by types of LTCF, HALT-3, 2016–2017

Type of LTCF	N of eligible residents	N of residents with HAI (all HAI origins)	Prevalence (%) of residents with at least one HAI				N of residents with antimicrobial agent(s)	Prevalence (%) of residents with at least one antimicrobial agent			
			HAI%	P25	Median	P75		AU%	P25	Median	P75
LTCFs for mentally disabled persons	4 978	87	1.7	0.0	0.0	0.0	180	3.6	0.0	0.0	4.2
Rehabilitation centres	4 482	295	6.6	0.0	5.4	12.7	319	7.1	0.0	7.3	14.3
Psychiatric LTCFs	1 891	34	1.8	0.0	0.0	3.1	56	3.0	0.0	3.3	8.1
Palliative care centres	366	55	15.0	0.0	3.7	23.5	71	19.4	3.2	12.5	25.0
LTCFs for physically disabled persons	57	5	8.8	5.6	12.5	15.4	9	15.8	0.0	5.6	87.5
Other LTCFs	3 063	40	1.3	0.0	0.7	3.9	61	2.0	0.0	0.8	11.1
Total	**14 837**	**516**	**3.5**	**0.0**	**0.0**	**6.7**	**696**	**4.7**	**0.0**	**2.0**	**11.1**

HAI%: crude prevalence, i.e. (number of eligible residents with at least one HAI / number of eligible residents) × 100;
AU: antimicrobial use.

In the specialised LTCFs, 696 residents received at least one antimicrobial agent (4.7%). The median prevalence of residents with at least one antimicrobial agent was 0.0% overall, and ranged from 0.0% in LTCFs for mentally disabled persons to 12.5% in palliative care centres.

There were 761 antimicrobial agents prescribed. Most were given orally (90.7%), while a parenteral or other administration route was used by 8.7% and 0.7%, respectively.

Antimicrobials were most frequently prescribed in this setting for the treatment of an infection (70.7%). Prophylaxis accounted for 29.2% of the total use. The indication was missing for one antimicrobial agent (0.1%). The most common indications for treatment were for RTIs (30.3%), UTIs (29.4%) and skin or wound infections (21.2%). Prophylactic prescriptions were mainly for the prevention of UTIs (46.0%), RTIs (25.2%) and skin or wound infections (11.3%).

Antibacterials for systemic use (ATC J01) accounted for 91.1% of all reported antimicrobials. Antibiotics used as intestinal anti-infectives (ATC A07AA; 3.0%), nitroimidazole-derived antiprotozoals (ATC P01AB; 2.1%), antimycobacterials for treatment of tuberculosis (ATC J04A; 1.7%), antimycotics for systemic use (ATC J02; 1.5%), and antifungals for systemic use (ATC D01BA; 0.7%) were less frequently prescribed in the participating specialised LTCFs.

There were 693 antibacterials for systemic use (ATC J01) recorded. The most frequently used classes within this group were, penicillins (J01C; 35.2%), quinolones (J01M; 14.0%), 'other antibacterials' (J01X; 12.7%), sulfonamides and trimethoprim (J01E; 12.1%), and 'other beta-lactams' (J01D; 11.1%). The distribution of antibacterials for systemic use (ATC J01) is presented by types of specialised LTCF and indication in Table 34.

Table 34. Distribution of antibacterials for systemic use (ATC J01) in specialised LTCFs, by indication, class and types of LTCF, HALT-3, 2016–2017

Antibacterials for systemic use (ATC J01)	LTCFs for mentally disabled persons		Rehabilitation centres		Psychiatric LTCFs		Palliative care centres		LTCFs for physically disabled persons		Other LTCFs		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
For prophylaxis	**90**	**100**	**65**	**100**	**16**	**100**	**14**	**100**	**2**	**100**	**19**	**100**	**206**	**100**
Tetracyclines (J01A)	16	17.8	1	1.5	0	0.0	1	7.1	0	0.0	0	0.0	18	8.7
Amphenicols (J01B)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Penicillins (J01C)	8	8.9	9	13.8	2	12.5	1	7.1	1	50.0	5	26.3	26	12.6
Other beta-lactams (J01D)	10	11.1	4	6.2	5	31.3	0	0.0	0	0.0	1	5.3	20	9.7
Sulfonamides and trimethoprim (J01E)	17	18.9	16	24.6	1	6.3	8	57.1	0	0.0	7	36.8	49	23.8
Macrolides, lincosamides and streptogramins (J01F)	16	17.8	6	9.2	0	0.0	3	21.4	0	0.0	1	5.3	26	12.6
Aminoglycosides (J01G)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	5.3	1	0.5
Quinolones (J01M)	3	3.3	13	20.0	0	0.0	0	0.0	1	50.0	0	0.0	17	8.3
Combinations of antibacterials (J01R)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Other antibacterials (J01X)	20	22.2	16	24.6	8	50.0	1	7.1	0	0.0	4	21.1	49	23.8
For treatment	**94**	**100**	**260**	**100**	**40**	**100**	**48**	**100**	**7**	**100**	**38**	**100**	**487**	**100**
Tetracyclines (J01A)	9	9.6	2	0.8	0	0.0	1	2.1	0	0.0	2	5.3	14	2.9
Amphenicols (J01B)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Penicillins (J01C)	47	50.0	92	35.4	26	65.0	28	58.3	3	42.9	22	57.9	218	44.8
Other beta-lactams (J01D)	8	8.5	37	14.2	3	7.5	5	10.4	0	0.0	4	10.5	57	11.7
Sulfonamides and trimethoprim (J01E)	5	5.3	25	9.6	1	2.5	3	6.3	0	0.0	1	2.6	35	7.2
Macrolides, lincosamides and streptogramins (J01F)	13	13.8	13	5.0	2	5.0	2	4.2	1	14.3	6	15.8	37	7.6

Antibacterials for systemic use (ATC J01)	LTCFs for mentally disabled persons		Rehabilitation centres		Psychiatric LTCFs		Palliative care centres		LTCFs for physically disabled persons		Other LTCFs		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Aminoglycosides (J01G)	0	0.0	6	2.3	0	0.0	0	0.0	0	0.0	0	0.0	6	1.2
Quinolones (J01M)	9	9.6	55	21.2	5	12.5	6	12.5	3	42.9	2	5.3	80	16.4
Combinations of antibacterials (J01R)	0	0.0	1	0.4	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2
Other antibacterials (J01X)	3	3.2	29	11.2	3	7.5	3	6.3	0	0.0	1	2.6	39	8.0

3.3.1 LTCFs for mentally disabled persons

Nine countries/administrations reported data for 178 LTCFs for mentally disabled persons. Most of these were units in Sweden (n=117; 65.7%), as well as LTCFs in Ireland (17.4%) and Hungary (6.7%) (Table 3). The median size of the LTCFs was 12 beds (mean: 31.1 beds).

The type of ownership was known for 61 LTCFs (34.3%). Of these, 62.3% were public LTCFs. Medical care was primarily provided by personal GPs (85.4%) and the majority had a coordinating physician (91.0%).

A person with training in infection prevention and control (IPC) was present in 74.9% of the LTCFs. External ICP 'help and advice' was available in 79.5% of the LTCFs. Hand disinfection with alcohol solution was the most commonly reported main hand hygiene method (75.2%). Surveillance of antimicrobial-resistant microorganisms, antimicrobial use and/or HAIs was performed in 68.5%, 70.8% and 32.7% of the facilities, respectively.

There were 4 978 eligible residents in these 178 LTCFs. A relatively large proportion were older than 85 years (median 37.5%), and the median percentage of male residents was 37.5%. The median percentage of disorientation and urinary/faecal incontinence was notably high (87.5% and 64.2%, respectively). The median percentage of residents with impaired mobility was 33.3% (Table 31).

The median percentage of residents with a urinary or vascular catheter or recent surgery was 0.0% in all 178 LTCFs. Some LTCFs reported residents with 'other wounds' (median: 2.3%).

An HAI was reported in 87 (1.7%) eligible residents, although the median prevalence of residents with at least one HAI was 0.0% (Table 33). There were 89 HAIs reported, with 87 (97.8%) associated with the current LTCF. One eye infection was attributed to a hospital stay and the origin of the HAI was unknown for one 'other infection'. The majority of the HAIs associated with the current LTCF were RTIs (39.1%, of which 44.1% were lower RTIs), UTIs (25.3%, of which 77.3% were probable UTIs), skin infections (25.3%, of which 77.3% were cellulitis/soft tissue/wound infections) and eye, ear, nose, mouth infections (5.7%, of which 80% were ear infections) (Table 32).

There were 180 (3.6%) residents in LTCFs for mentally disabled persons who were reported to have used at least one antimicrobial agent on the day of the survey. The median prevalence of residents with at least one antimicrobial was 0.0% (Table 33). A total of 188 antimicrobial agents were prescribed, of which 97.9% were administered orally. One antimicrobial agent (0.5%) was administered parentally, and two (1.1%) were administered via another route. The route of administration was missing for one antimicrobial (0.5%).

Similar proportions of the prescriptions were for prophylaxis (47.9%) rather than treatment (52.1%). Prophylaxis (n=90) was most frequently for the prevention of UTIs (44.4%), RTIs (35.6%) and skin or wound infections (17.8%); while treatment (n=98) was mainly for RTIs (34.7%), skin or wound infections (28.6%) and UTIs (23.5%).

Antibacterials for systemic use (ATC J01) represented 97.9% of all reported antimicrobials. In addition, there were three prescriptions of antiprotozoals (ATC P01; 1.6%) and one antimycotic for systemic use (ATC J02; 0.5%). Among antibacterials for systemic use (J01, n=184) were penicillins (J01C; 29.9%); macrolides, lincosamides and streptogramins (J01F; 15.8%); tetracyclines (J01A; 13.6%), 'other antibacterials' (J01X; 12.5%), and sulfonamides and trimethoprim (J01E; 12.0%). The distribution of antibacterials for systemic use (ATC J01) in specialised LTCFs, by indication, class and by type of LTCF is presented in Table 34.

3.3.2 Rehabilitation centres

Six countries/administrations reported data for 156 rehabilitation centres. Most of them were units in Portugal (79.5%) and Sweden (7.1%), and LTCFs in Italy (6.4%) (Table 3). Of the 145 LTCFs for which the ownership was known, 22.8% were public institutions. The rehabilitation centres had a median size of 20 beds (median: 32.8 beds).

Personal GPs were in charge of medical care in 24.4% of the rehabilitation centres, while in 43.6% of the LTCFs, an employed medical staff provided this service. In 32.1% of the centres, medical care was provided by both personal GPs and a fixed medical staff. Almost all centres (96.8%) had a coordinating physician.

A person with IPC training and external IPC 'help and advice' was available in 79.5% and 79.7% of the rehabilitation centres, respectively. The majority of the centres reported hand disinfection with alcohol solution as the main hand hygiene technique (79.7%; n=122/153). Surveillance of antimicrobial-resistant microorganisms, antimicrobial consumption and HAIs was performed in 52.6% (n=82/156), 52.3% (n=81/155) and 52.3% (n=80/153) of the rehabilitation centres, respectively. All three surveillance programmes were in place in 31.6% (n=48/152) of the participating centres.

In total, 4 482 residents were included in the survey, of which 20.0% of the residents were older than 85 years and 43.8% were male (median proportions). Impaired mobility and incontinence were present in more than half of the residents: a median of 50.0% and 61.7%, respectively. Wounds were relatively common in rehabilitation centres compared to other types of LTCF: a median of 10.4% had a pressure sore, 14.3% had another kind of wound and 9.1% had a urinary catheter (Table 31).

On the day of the survey, 295 residents had at least one HAI (crude prevalence: 6.6%). The median HAI prevalence was 5.4% (Table 33). Of the 301 reported HAIs, 62.5% were associated with the current LTCF, 26.6% with a hospital, and 2.3% with another LTCF. The HAI origin was unknown for 26 HAIs (8.6%).

The types of HAI associated with the current LTCF (n=188) were mainly RTIs (38.8%), UTIs (30.3%) or skin infections (17.0%). Less common types were eye, ear, nose, mouth infections (5.9%), gastrointestinal infections (3.7%) and 'other infections' (2.1%) (Table 32).

Among the 4 482 eligible residents, 319 (7.1%) received one or more antimicrobial agent. The median prevalence of residents with at least one antimicrobial agent was 7.3% (Table 33).

Overall, 352 antimicrobial agents were prescribed. The majority (79.6%) were for treatment, more specifically for UTIs (34.6%), RTIs (29.6%), or skin or wound infections (16.4%).

Prophylaxis accounted for 20.5% of the total antimicrobial use in this type of LTCF. The main indications were prevention of UTIs (37.5%), RTIs (20.8%) and skin or wound infections (11.1%).

Antimicrobials were mainly prescribed orally (87.8%) or parenterally (11.7%). Only two antimicrobial agents (0.6%) had another route of administration.

Antibacterials for systemic use (ATC J01) represented 92.3% of all reported antimicrobials. There were less frequent prescriptions of antimycobacterials for treatment of tuberculosis (ATC J04A; 3.7%), antibiotics used as intestinal anti-infectives (ATC A07; 1.7%), antiprotozoals (ATC P01; 1.1%), antifungals for systemic use (ATC D01BA; 0.6%) and antimycotics for systemic use (ATC J02; 0.6%).

The most commonly prescribed classes of antibacterials for systemic use (J01) by indication for treatment in rehabilitation centres are presented in Table 34. The most frequent classes of antibacterials for systemic use (J01) prescribed in rehabilitation centres were penicillins (J01C; 31.1%), quinolones (J01M; 20.9%), 'other antibacterials' (J01X; 13.9%), 'other beta-lactams' (J01D; 12.6%), and sulfonamides and trimethoprim (J01E; 12.6%).

3.3.3 Psychiatric LTCFs

Eight countries/administrations reported data for 41 psychiatric LTCFs. Most of these facilities were LTCFs in Ireland (56.1%) and Hungary (17.1%) (Table 3). The majority of the psychiatric LTCFs (n=37; 4 missing) were public institutions (81.1%). The median size of these LTCFs was 26 beds (mean: 52.8 beds).

Medical care was provided by personal GPs (43.9%), by medical staff employed by the LTCF (31.7%) or by both (24.4%). A coordinating physician was present in 78.0% of these LTCFs.

A person with IPC training was available in 63.4% of the LTCFs, and external IPC 'help and advice' was available for 70.7% of the LTCFs. Hand disinfection with alcohol solution was the main hand hygiene method used in 61.0% of psychiatric LTCFs. In total, surveillance of HAIs, antimicrobial-resistant microorganisms and antimicrobial consumption was present in 27.5%, 23.1% and 21.1% psychiatric LTCFs, respectively.

The median proportion of residents who were older than 85 years was less than 1%, and the median proportion who were male was 55.0%. Very few of the residents of psychiatric LTCFs had any of the four risk factors that were recorded in HALT-3. Indeed, the median percentage of these was 0.0%. The median percentages of the care load indicators – incontinence, disorientation and impaired mobility, were 41.2%, 23.1% and 18.4%, respectively (Table 31).

There were 34/1 891 (1.8%) eligible residents with at least one HAI on the day of the survey. The median prevalence of residents with at least one HAI was 0.0% (Table 33).

3.3.4 Palliative care centres

Five countries/administrations reported data for 26 palliative care centres, of which 12 were units in Portugal (46.2%). The other centres were LTCFs in Ireland (26.9%), Italy (11.5%), Slovakia (11.5%) and Czechia (3.8%). Their median size was 15.5 beds (mean: 18.6 beds). Private centres accounted for 26.9% of these LTCFs.

Most of these palliative care centres had an employed medical staff member in charge of the medical resident care (73.1%) and all of the centres had a coordinating physician. In three (11.5%) centres, a personal GP came to the LTCF to examine residents. Four centres reported that medical care was provided by a combination of both personal GPs and employed medical staff.

Fourteen palliative care centres (53.8%) had a person with IPC training within the centre and access to external IPC 'help and advice'. Six (23.1%) centres only had a person with IPC training available within the LTCF, while the remaining six (23.1%) only had access to external IPC 'help and advice'. The majority of the centres predominantly used hand disinfection with an alcohol solution for hand hygiene. Surveillance of antimicrobial-resistant microorganisms, HAIs and antimicrobial consumption was in place in 48.0%, 46.2% and 40.0% centres, respectively. Seven centres (26.9%) had all three of these surveillance activities.

There were 366 eligible residents. The median percentages that were male and/or age over 85 years were 41.6% and 14.3%, respectively.

Compared to the other participating specialised types of LTCFs, the palliative care centre residents had more of the examined risk factors, i.e. urinary catheter use (median: 27.3%), vascular catheter use (11.1%), pressure sores (18.2%) and 'other wounds' (18.8%). Moreover, these centres had the highest median percentage of impaired mobility (85.2%) (Table 33).

3.3.5 LTCFs for physically disabled persons

Three countries/administrations (Ireland, Italy and UK-Wales) each reported data for one LTCF for physically disabled persons. Two of these LTCFs were public facilities. Their mean size was 23.3 beds (median: 20 beds).

Medical care was provided by general GPs in UK-Wales, by an employed medical staff in the participating LTCF in Ireland, and by both GPs and an employed medical staff in the LTCF in Italy. Two of the LTCFs had a coordinating physician.

All three LTCFs had a person with IPC training within the facility. In addition, two LTCFs could acquire external IPC 'help and advice'. Two LTCFs reported hand washing with water and soap as their main hand hygiene technique. One LTCF performed surveillance of antimicrobial consumption, while another had a surveillance of HAIs in place. None of the three LTCFs monitored antimicrobial-resistant microorganisms.

Data were collected from 57 residents. None of these residents were older than 85 years, and the median percentage of males was 38.5%. Urinary catheter use in this population was relatively frequent (median: 7.7%). The median percentages for the care load indicators were high: 76.9% impaired mobility, 75.0% incontinence and 62.5% disorientation (Table 31).

Five eligible residents had an HAI on the day of the survey. The crude and median prevalence of residents with at least one HAI were 8.8% and 12.5%, respectively (Table 33). Four HAIs were associated with the current LTCF. These were one case each of conjunctivitis, fungal infection, lower RTI and cellulitis/soft tissue/wound infection (Table 32). One gastroenteritis was associated with a hospital stay.

Nine (15.8%) of the 57 residents received at least one antimicrobial agent on the day of the survey. The median prevalence of residents who received at least one antimicrobial was 5.6% (Table 33). Nine antimicrobials (90.0%) were administered orally, while one (10.0%) was administered parenterally.

Eight antimicrobials (80.0%) were prescribed for treatment, of which three were for RTIs (37.5%), two were for gastrointestinal infections (25.0%), two were for skin or wound infections (25.0%), and one was for a UTI (12.5%). Two antimicrobials (20.0%) were prescribed for prophylaxis: one for the prevention of a skin or wound infection, and one for the prevention of a UTI. The prescribed antimicrobials were nine antibacterials for systemic use (ATC J01; 90.0%) and one antibiotic used as intestinal anti-infective (A07AA; 10.0%).

The most commonly prescribed classes of antibacterials for systemic use (ATC J01) by indication for treatment in LTCFs for physically disabled persons are presented in Table 34.

3.3.6 Other LTCFs

Thirty-one LTCFs participating in the survey were classified as 'other LTCFs'. These LTCFs were located in Hungary (54.8%), Ireland (29.0%), Italy (12.9%) and Germany (3.2%) (Table 3). They were mostly private facilities (71.9%) and had a median size of 72 beds (mean: 107.2 beds).

Most 'other LTCFs' had personal GPs providing medical care to the residents (71.0%) and a practitioner coordinating medical care (74.2%). In addition, 58.1% of the 'other LTCFs' had a person with IPC training and almost all (90.3%) had access to external IPC 'help and advice'.

Hand washing with water and soap was more commonly reported as main hand hygiene method compared to hand disinfection (58.1% versus 41.9%). Nine 'other LTCFs' (29.0%) had a surveillance system for antimicrobial-resistant microorganisms and seven (22.6%) monitored HAIs. Only one LTCF (3.2%) monitored antimicrobial consumption.

Data were collected for 3 063 residents, of which half were male (crude: 49.7%). Remarkably few residents were older than 85 years (crude: 9.8%; median: 4.4%). The examined risk factors were uncommon (median <2%), especially when compared to the median percentages of incontinence (45.5%) and disorientation (47.4%) (Table 31).

Out of the 3 063 eligible residents, 40 had at least one HAI on the day of the survey (crude prevalence: 1.3%). The median prevalence of residents with at least one HAI was 0.7% in these 'other LTCFs' (Table 33).

HAIs were mostly associated with the current LTCF (77.5%), while 12.5% were associated with a hospital. The origin of infection was unknown for 10.0% of the HAIs.

The most frequently reported HAIs in 'other LTCFs' were skin infections (41.9%), of which 69.2% were cellulitis/soft tissue/wound infections and 30.8% were fungal infections. The second most common HAIs were RTIs (35.5%; of which 45.5% were common colds/pharyngitis, and 54.5% were lower RTIs). The remaining infections were UTIs (22.6%; of which 71.4% were classified as probable; Table 32)

Sixty-one residents received an antimicrobial agent on the day of the survey. The crude and median prevalence percentages of residents with at least one antimicrobial agent were 2.0% and 0.8%, respectively (Table 33). A total of 63 antimicrobials were prescribed, of which 66.7% were for treatment and 33.3% were for prophylaxis. Antimicrobial treatment was mainly for skin or wound infections (33.3%), UTIs (28.6%) and RTIs (23.8%). UTIs were the main indication for prophylactic use in 'other LTCFs' (81.0%).

The majority of antimicrobials were administered orally (96.8%). One antimicrobial (1.6%) was administered parenterally, while one (1.6%) was given via another administration route.

Antibacterials for systemic use (ATC J01) represented 90.5% of all reported antimicrobials. There were a few prescriptions of antibiotics used as intestinal anti-infectives (A07AA; 3.2%), antifungals for systemic use (D01BA; 3.2%), antimycotics for systemic use (J02; 1.6%) and antiprotozoals (P01; 1.6%). Overall, penicillins (J01C) accounted for 47.4% of all prescribed antibacterial agents for systemic use (J01).

The most commonly prescribed classes of antibacterials for systemic use (J01) by indication for treatment in 'other LTCFs' are presented in Table 34.

4 Discussion and conclusions

4.1 Participation

The HALT-3 was the largest survey of its kind, with 3 052 LTCFs recruited by 24 EU/EEA countries. It surpassed the size of the HALT-2 (2013) PPS, which included 1 181 LTCFs in 19 European countries/administrations; and the HALT (2010) PPS, which included 722 LTCFs across 28 European countries/administrations [1, 2]. Indeed, 11 countries had recruited so many LTCFs that a systematic random sample of their LTCFs was drawn either on the national or European level, to prevent the overrepresentation of these countries, resulting in 2 232 LTCFs in the final EU/EEA dataset. For the first time, EU candidate and potential candidate countries were invited to participate; both North Macedonia and Serbia recruited LTCFs.

More than two-thirds of countries/administrations had a 'good' or 'optimal' representativeness of their national LTCF sample, which exceeded the representativeness achieved in HALT-2 (i.e. 69% versus 53% EU/EEA countries). The only three countries in HALT-3 that drew a systematic random sample of their national LTCFs (France, Norway and Sweden) obtained these from their national, HALT-like, PPS datasets.

In several countries, systematic sampling was not possible due to the non-existence of national register of LTCFs. More generally, recruiting LTCFs to participate voluntarily was often burdensome for countries. National teams commonly consisted of just one or two people, who often also worked on the semi-concurrent ECDC PPS in acute care hospitals. Countries that did not participate in HALT-3, directly cited insufficient resources, such as staff, at the national level. Slovenia did not participate in HALT-3, whereas previously, their national team had recruited six LTCFs for HALT (2010) and two LTCFs for HALT-2 (2013). During wave 1 of HALT-3, the University of Ljubljana (UL) and the University Medical Centre Ljubljana (UMCL) conducted a PPS in 80 LTCFs, which represents more than two-thirds of the LTCFs in Slovenia. The protocol was based on the HALT (2010) protocol, collecting data on antimicrobial use and institutional-level indicators, but it omitted the collection of HAI data [17].

The HALT-3 protocol designation of national representativeness as 'poor' or 'very poor' does not reflect on the quality of the PPS in those countries/administrations, but rather confers the level of confidence with which results from LTCFs in a country/administration can be extrapolated to that entire country/administration. For example, Poland and Luxembourg recruited more residents and a similar number of LTCFs compared to UK-Wales, which had a 'good' national representativeness. However, these two countries required a larger sample size, due to their national number of total beds and their average LTCF size. Importantly, a stated objective of HALT-3 was 'to identify priorities for national and local intervention in LTCFs, and to evaluate their implementation' [3]. HALT-3 supported national efforts to raise awareness of IPC in LTCFs and beyond. We believe that this knowledge will also disseminate to the professional networks of LTCF staff.

Between 2009 and 2015, five countries (France, Ireland, the Netherlands, Norway and Sweden) initiated periodic national PPSs in LTCFs, compatible with, or based on the HALT methodology. The conversion of compatible national data to HALT-3 was feasible for countries with such data. Discrepancies compared to the HALT-3 protocol were managed through imputation or omission. For example, the national protocols of France and Norway do not include all types of HAI, so these were imputed based on the relative proportion of those types compared to other types of HAI in the entire dataset. In addition, Sweden had implemented a web-based data entry system for 'Svenska HALT', directly based on HALT-2. This resulted in excellent national coverage and enabled rapid report-generation times. However, the resident-level aspects of the Swedish software could not be updated for this survey. Therefore, Sweden's AMR and microbiological data are not directly comparable with HALT-3, and Sweden also did not acquire data on imported HAIs.

Unlike previous HALT PPSs, there were four surveillance waves, to promote participation. Notably, the majority of countries/administrations participated in the last wave and only three countries participated in more than one wave. ECDC offered an additional surveillance wave for non-participating countries to only collect LTCF-level data. One country (Czechia) did this. The timing of the four waves was chosen to match those of the concurrent ECDC PPS of HAIs and antimicrobial use in European acute care hospitals. This was to enable linked analyses by national teams, although this was not a European-level objective of HALT-3 or the ECDC PPS in acute care hospitals. Only Portugal did both PPSs in the same surveillance wave. Other countries reported that the required extra workload prohibited this. To offset a negative impact arising from the long duration of HALT-3, each country/administration that had participated in a surveillance wave received LTCF-level feedback reports, comparing each LTCF to their national dataset, immediately following the surveillance wave.

Optional onsite assessment visits by a member of the HALT-3 management team were requested by 13 countries/administrations. These provided the HALT-3 management team with valuable insights into country/administration-specific differences and provided assistance to countries in their acquisition of national-level structure and process indicators. The update of the 2010 national-level study [18] will be published separately.

All EU/EEA countries had been urged to recruit one LTCF each for the HALT-3 validation study, to enable adjustment of EU/EEA estimates. However, despite the offer of direct assistance by a member of the HALT-3 management team during an optional onsite-assessment visit, only a third of the countries/administrations performed validation studies, recruiting half the intended number of LTCFs. This reduced the accuracy of the estimates of sensitivity and specificity. The reasons for not organising validation studies included insufficient resources at the national level, or legal or ethical constraints in some cases, which did not allow an external team to review residents' data. By contrast, the PPS in European acute care hospitals had validation studies for 28 out of 31 participating countries (UK administrations counted separately). Unlike the HALT-3 validation studies, the validation studies in acute care hospitals were partially funded by ECDC.

Comparisons between the HALT (2010), HALT-2 (2013) and HALT-3 PPSs should be made with caution, while considering the differences in their methodology, the different countries that participated and the representativeness of their LTCF sample in each survey, the absence of an identifier to track individual LTCFs between surveys, and the pitfalls of the PPS methodology, including the stochastic effect arising from single-day data collection. For these reasons, EU/EEA-level comparisons are more valid than national-level comparisons.

4.2 Training

The HALT-3 protocol recommended central training of local data collectors, to ensure a uniform data collection methodology, although it was often not feasible for national teams to train all local data collectors. In some countries, the national teams had to perform all the data collection activities themselves. The HALT-3 protocol for the optional national onsite assessment visits allowed for the collection of information on the level of training that was acquired by local data collectors, although this was completed only by 13/28 countries.

Due to the long duration between the train-the-trainers workshop in December 2015 and the third and fourth surveillance waves, ECDC organised a series of refresher webinars, available to national and local teams, with participation from countries/administrations that had already completed data collection. The webinars were attended by eight countries/administrations that had not yet performed the survey, and three countries/administrations that had already completed data collection during the first or second wave. Materials from the webinars, including recordings, were subsequently published on an ECDC webpage, with a special focus on validation studies, to enable onward distribution to other trainers and data collectors [14].

4.3 Types of participating LTCFs

Perhaps most notably, the reported number of available LTCF beds per population varied considerably between countries. There were LTCF beds available for 0.03% of the population in Bulgaria, and for 9% of the population in Denmark. The overall median availability in EU/EEA countries was 4.1%.

As in the HALT (2010) and HALT-2 (2013) PPSs, the vast majority of recruited LTCFs were nursing homes, residential homes and mixed facilities. Unlike the previous surveys, the other types of LTCF recruited in this survey have a separate chapter each in this report.

The onsite assessment visits and post-survey network meeting confirmed that aggregating data for the three most common types of LTCF is useful, to smooth over the differences in the national interpretation of the definitions of the types of LTCF in their national setting. The HALT (2010) report stratified the results for these three main types of LTCF, and did not identify major differences in the prevalence of HAIs or antimicrobial use [1]. Nonetheless, it should be noted that this aggregated group is not homogenous. For example, Poland highlighted that there are pronounced and categorical differences between residential homes and mixed facilities in the country. This was similar to Finland, which is why they chose only to submit data for nursing home units and not for residential home units.

Portugal recruited the second largest number of LTCFs of any country, of which half met the definition of one of the three main types of LTCF. The mixed facilities in Portugal bore similarities to primary care hospitals, with more of a ward-like structure than in other countries. Units within these LTCFs were included in HALT-3 separately, as they were generally very different from one another. LTCFs could have up to four types of unit, which were 'palliative care units' (until end of life), 'convalescence units' (usually <1 month stays), 'medium term and rehabilitation units' (1–3 month stays), and 'long term and maintenance units' (>3 month stays) [19].

The LTCFs recruited by Spain, which were all mixed facilities, were mostly post-acute (step-down) care facilities, particularly those located in the autonomous region of Catalonia. UK-Wales excluded 'non-acute' hospitals from its HALT-3 PPS, rather including these in its PPSs using the ECDC PPS protocol for acute care hospitals [20]. It was apparent, during both the pre-survey and post-survey network meetings, that there remains an unmet need to update the ESAC-NH-derived definitions of types of LTCF, for pan-European surveys in LTCFs.

Therefore, differences in the nationally recruited types of LTCF will partially explain variations in the recorded prevalences and distributions of structure and process indicators of IPC and antimicrobial stewardship. The multivariable analyses presented in this report sought to allow for differences in the case mix of LTCFs, to identify both the association with the prevalence of HAIs or antimicrobial use, and also risk factors that are amenable to targeted interventions.

4.4 Healthcare-associated infections

4.4.1 Prevalence and burden

The prevalence of residents with at least one HAI was 3.7%, when considering HAIs of all origins. The HALT-2 (2013) survey only considered HAIs associated with the current LTCF. In the HALT-2 survey, the prevalence of HAIs was of a similar magnitude as the equivalent subset of HAIs recorded in the current survey (3.4% versus 3.1%) [2]. Neither the HALT-3 nor the HALT-2 (2013) PPSs can be compared to the HALT (2010) PPS which used a different methodology to identify HAI cases. In 2010, data collectors recorded all signs/symptoms and modified McGeer criteria were applied during analysis [1]. By contrast, to minimise observer bias, HALT-2 and HALT-3 used decision algorithms in which data collectors identified if a resident met US CDC/SHEA-based HAI case definitions, by ticking signs/symptoms of infection on a data collection form. This latter approach is now commonly used in Europe in national PPSs in LTCFs [10-12].

The point estimate for the total annual number of HAIs in general nursing homes, residential homes and mixed facilities in the EU/EEA was very similar in HALT-3 (4.4 million HAIs (95% cCI: 2.0–8.0 million)) compared to HALT-2 (2013; 4.2 million HAIs). In HALT-3 however, HAI prevalence was weighted for the average number of occupied LTCF beds per country and corrected using the validation study results. Although we assumed that these HAIs affected a smaller number of residents, this number could not be estimated, as no published incidence surveys were known to the HALT-3 team or the OCPs. Notably, the number of HAIs in LTCFs in the EU/EEA is of equal magnitude to the estimated annual 4.5 million (95% cCI: 2.6–7.6 million) HAIs in acute care hospitals in the EU/EEA [15].

In the HALT-3 PPS, the three most commonly reported types of HAI associated with the current LTCF were RTIs, UTIs and skin infections. Together, these three types accounted for nine out of 10 HAIs in LTCFs. Interestingly, this ranking and proportion was the same in the HALT-2 (2013) PPS [2]. In the HALT (2010) PPS, the three most common types of HAI were also the same, although they accounted for only eight out of 10 HAIs [1].

The HALT-3, as well as the HALT (2010) and HALT-2 (2013) surveys, were all PPSs. Their 'snapshot' design is inherently less accurate than well-performed incidence surveillance, but they are more feasible for countries and LTCFs. Therefore, PPSs can obtain more accurate national and European estimates of the burden of HAIs. Still, the 'snapshot' described in the HALT-3 protocol is likely to miss LTCF residents with HAIs that required hospitalisation. Indeed, in HALT-2 (2013), 1.7% of the LTCF residents were absent due to hospitalisation (data not collected in HALT-3). Similarly, LTCFs that are busy managing outbreaks would probably decline concurrent participation in a PPS. For this reason, HALT-3, as in the previous HALT PPSs, had surveillance waves outside of the outbreak seasons. This is likely to have resulted in an underestimation of the prevalence of more outbreak-prone infections. A mid-winter surveillance period would most probably have identified more upper RTIs and influenza. In the HALT-3 PPS, flu was very rarely reported (only 0.3% of all reported HAIs). Slovakia, which performed its PPS at the beginning of its 2017/2018 upper RTI season, reported a percentage of 'common cold/pharyngitis' that was 6.4-times the EU/EEA average. A mid-summer PPS would have identified more gastrointestinal infections while HALT-3 identified relatively few.

The sensitivity of data collection of HAIs in the HALT-3 PPS (79%; 95% CI: 64–89%) was similar to the sensitivity in the HALT-2 PPS (76%; 95% CI: 58–89%). Moreover, the specificity of HAI identification was also near 100% in both surveys. Despite the fact that participation in the validation study was lower than intended, with incomplete representation of some countries, it was undoubtedly useful to give some indication of the magnitude of the under-ascertainment of HAIs by primary survey teams.

The validation survey did not stratify results by types of HAI, although there were probably differences between the types. For example, in Denmark, almost all recorded antimicrobial treatment, and half of all antimicrobial prophylaxis was for UTIs, yet UTIs represented a third of all reported types of HAI. Denmark did not perform a HALT-3 validation study, but reported that it may have been particularly common for residents who received antimicrobial treatment for a UTI to have had insufficient documentation of relevant signs/symptoms. This would imply an underestimation of the UTI and HAI prevalence in Denmark. ECDC plans to include, in a future output, a tabulation of the number of residents receiving antimicrobial treatment for a specific type of HAI compared to those who met the associated case definition.

As noted above, the reported HAI prevalence figures for France, the Netherlands and Norway are estimates, containing data imputed from the EU/EEA average in the HALT-3 PPS, as their national surveillance systems did not collect data for all HAIs. The EU/EEA average from 2016–2017 was preferred over data from the participation of these countries in the HALT (2010) PPS, due to the methodological differences between the two PPSs; or from the HALT-2 (2013) PPS, due to the poor national representativeness of the LTCF sample of those countries. Also, Sweden and France did not collect data on HAIs acquired in other healthcare facilities, as they had aligned their national protocols with the HALT-2 (2013) protocol. These missing data were not imputed, and so the prevalence of residents with at least one HAI (all HAI origins) might have been underestimated for France and Sweden by as much as 9–15%.

Spain had the highest reported HAI prevalence, but this can partially be explained by the post-acute (step-down) nature of the LTCFs that participated in Catalonia compared to those participating in the region of Madrid. The HAI prevalence in LTCFs in Catalonia was 11.6%, while in LTCFs in Madrid it was 6.1%.

4.4.2 HAIs from other facilities

The HALT-3 PPS was the first ECDC PPS to collect data on all HAIs in LTCFs, i.e. not merely HAIs acquired in the participating LTCFs, but also those acquired in other healthcare facilities, such as acute or chronic care hospitals and other LTCFs. This added significant complexity to the HALT-3 protocol and consequently to the training courses. This also resulted in the requirement to include a case definition for surgical site infections in the decision algorithms. This addition may explain the lower proportion of skin infections in the HALT-3 PPS compared to the HALT-2 PPS, due to erroneous classification of SSIs as skin infections in the HALT-2 PPS. There were 14 SSIs (0.4% of all HAIs) that were reported to have been associated with the 'current LTCF', even though facilities that perform surgery would not meet the HALT-3 inclusion criteria for LTCFs. Although these could have been data errors, no data recoding was performed, as several of these SSIs were in LTCFs that may have performed minor surgical interventions, due to their post-acute care characteristics.

The majority (84.7%) of reported HAIs in the HALT-3 PPS were associated with the current LTCF, while almost one in 10 HAIs (8.9%) were attributed to a stay in another healthcare facility. During the ECDC network meeting on 6–7 March 2018, to discuss preliminary results from HALT-3, several OCPs expressed their concern that LTCFs may have attributed HAIs to other healthcare facilities, leading to an underestimated prevalence of residents with infections associated with the current LTCF.

HALT-3 was also the first ECDC PPS to permit reporting of HAIs that did not meet a strict case definition. These were 'imported' HAIs, i.e. residents who were recently transferred from another healthcare facility (e.g. hospital), who still received treatment for an HAI which had begun in the previous healthcare facility, but had insufficient documentation of the signs/symptoms that would have enabled HAI diagnosis by that facility. Although there could not be imported infections with an HAI origin reported as the 'current LTCF', some were coded as such in some national databases. Mostly the corrections of such miscoding were at the national level, in a non-standardised manner. During verification with these countries, these HAIs were most commonly recoded as confirmed infections (or probable infections in case of UTIs and in the absence of microbiological results), if they concerned residents who had been in the LTCF for more than one year and had no recent hospital stay. In the European database, the origin of HAIs was recoded from 'current LTCF' to 'unknown' if the HAI was reported as 'imported'. This was done for seven HAIs in six countries/administrations (Belgium, Denmark, Ireland, Italy, Spain and UK-Scotland).

The overall proportion of HAIs with an unknown origin was unexpectedly high (6.4%), and the highest in Lithuania (21.9%), Portugal (12.4%), Malta (12.3%) and Belgium (11.1%). The most commonly cited reasons were limited access of the data collectors to the residents' records (e.g. Lithuania), insufficient documentation in LTCFs, or because of the complexity of the HAI portion of the HALT-3 protocol. These findings, along with the difficulties encountered by local surveyors in identifying imported infections and the correct HAI origin, support the recommendation to omit the collection of data on HAIs associated with other healthcare facilities from European PPSs in LTCFs, in the future.

4.4.3 Antimicrobial resistance

Logically, a physician is more likely to contact an LTCF if a test result is positive, and especially if an antimicrobial-resistant microorganism is isolated. This may partially explain the surprisingly high percentage of AMR. The HALT-3 PPS only recorded AMR data for microorganisms that are known to be important, and AMR results were available for the majority (77%) of these microorganisms. In the HALT-3 PPS, a composite index of AMR was developed to present the percentage of isolates with known AST results that had AMR (first-level AMR markers included in the protocol). In total, almost a third (28.5%) of the isolates with known AST results showed AMR according to these first-level AMR markers.

Arguably, the most noteworthy result is that just over half of the residents with HAIs had a microbiological culture to guide effective treatment. Moreover, those who had a culture taken did not necessarily have available microbiological results. Overall in the HALT-3 PPS, almost a third of residents with an HAI did not have microbiological results available in their LTCF on the day of the survey; there were seven countries in which fewer than one in 10 residents with an HAI had these. In both the HALT-3 and HALT-2 PPSs, the actual microorganism was reported in microbiological results for only about a quarter of HAIs.

However, the HALT-3 protocol is likely to have underestimated the availability of microbiological data. Often this is held within the residents' medical records outside of the LTCF, and is transferred slowly to the residents' LTCF notes, if at all. For example, in Denmark although very few results were available in LTCFs or available to the LTCF staff completing the survey, they were available to GPs (C. Stab, personal communication). To maintain the feasibility of this cross-sectional (single day) survey, data collectors were not requested to collect missing microbiological data by revisiting residents' files after the day of the survey. Therefore, this PPS did not record the number of residents with HAIs who had microbiological results, but rather the number who had available microbiological results on the day of the survey. The national surveillance protocol data from France does require completion of this data after the survey day, so data from this country are complete [12]. Conversely, microbiological data were not collected in the national surveillance of Norway [9]. Additionally, as the national surveillance system in Sweden used the HALT-2 data format, AMR data from this country were only collected for residents who received an antimicrobial agent rather than those with an HAI.

Despite these modifying factors, the five most frequently reported microorganisms (*Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Proteus mirabilis* and *Pseudomonas aeruginosa*) remained the same as in the HALT-2 (2013) PPS, except that *Klebsiella pneumonia* is now the third most reported microorganism rather than the fifth. Other comparisons of microbiological data from this HALT-3 PPS with that of the HALT-2 (2013) or HALT (2010) PPSs should be made sparingly, as the data collection method was adapted for HALT-3 to match the method used in the ECDC PPS of HAI and antimicrobial use in acute care hospitals [8]. Microbiological data were collected for residents who met the HAI case definitions, rather than from those who received an antimicrobial agent.

4.4.4 Resident case mix

The stochastic effects inherent to the PPS methodology meant that it would not be particularly useful to compare the prevalence of HAIs in one LTCF between the three PPSs, even if the PPS protocols requested that national teams use the same identifier for LTCFs that participated in more than one PPS. Therefore, the use of a multivariable model to obtain an 'LTCF risk score' in HALT-3 may be useful to direct prevention activities. Additionally, the multivariable model allowed for the calculation of a standardised infection ratio for each LTCF, to identify LTCFs with a lower-than-expected HAI prevalence, suggesting either effective IPC or under-ascertainment; or a higher-than-expected HAI prevalence, suggesting the need for supportive investigations within that LTCF.

There were large differences between and within countries/administrations in the observed presence of care load indicators and risk factors for HAI and antimicrobial use. The multivariable analysis took into account two LTCF characteristics and resident characteristics that included care load and risk factors for HAIs. Several of these were independently and positively associated with a higher prevalence of HAIs. As the model only explained a fifth of the variation of the prevalence of HAIs in the included LTCFs, this implies that the included indicators of case mix only account for part of the differences in HAI prevalence.

4.4.5 HAIs in specialised facilities

The prevalence of residents with at least one HAI on the day of the survey in the most common types of LTCF that were presented in aggregate (i.e. general nursing homes, residential homes and mixed facilities; 3.7%) was exceeded in specialised centres such as rehabilitation centres (6.6%), LTCFs for physically disabled persons (8.8%; only three participating LTCFs) and palliative care centres (15.0%). The HAI prevalence was lower in psychiatric centres (1.8%), LTCFs for mentally disabled persons (1.7%) and other LTCFs (1.3%). For palliative care centres, there was a large difference between the crude prevalence percentage (15.0%) and the median prevalence (3.7%) as these had relatively few eligible residents and many did not report any HAI during the PPS.

In LTCFs for mentally disabled persons, rehabilitation centres, 'other facilities' and psychiatric centres, the three most frequently reported types of HAI, i.e. RTIs, UTIs and skin infections, were the same as in the three most common types of LTCF. In palliative care centres, these three types of HAI were also common but less common than eye, ear, nose and mouth infections; the overwhelming majority of the latter being cases of oral candidiasis.

4.5 Antimicrobial use

In this HALT-3 PPS, the prevalence of residents who received at least one antimicrobial agent on the day of the survey (4.9%) was similar to the prevalence found in the HALT (4.3%) and HALT-2 (4.4%) PPSs [1, 2].

Penicillins (ATC J01C), other antibacterials (J01X) and quinolones (J01M) remained the most commonly reported classes of antibacterial agents in this HALT-3 PPS (30.2%, 18.6% and 14.9%, respectively). These percentages were comparable to those reported in the HALT (28.7%, 19.4% and 15.5%, respectively) and HALT-2 (29.3%, 19.8% and 16.0%, respectively) PPSs [1, 2]. The next two most frequently reported antimicrobial classes also remained the same, although their order had changed: the percentage of sulfonamides and trimethoprim (J01E) and other beta-lactams (J01D) was 13.3% and 12.6%, respectively, while it was 11.9% and 12.5%, respectively, in the HALT-2 PPS [2]. Finally, there was a strong variation in the use of carbapenems (J01DH) between countries with only six countries reporting any carbapenem use (similar to four countries in HALT-2).

Antimicrobials were primarily administered orally in LTCFs. The percentage of oral prescriptions in the HALT-3 PPS (88.1%) was comparable to those in the previous PPSs in 2010 and 2013 [1, 2].

As in the previous HALT PPSs, treatment was the main indication for antimicrobial use (69.5%). Prophylaxis accounted for almost a third (29.4%) of all prescriptions, slightly more than in the HALT-2 PPS (27.2%). In the HALT-3 PPS, the proportion of total antimicrobials that were for prophylaxis of UTI (22.0%) remained the same as in the HALT-2 and HALT PPSs [1, 2].

At the national level, prophylaxis accounted for more than 40% of all antimicrobial use reported by Croatia, Denmark, Finland, Ireland, the Netherlands, UK-Northern Ireland and UK-Wales. Between five and six out of 10 antimicrobial agents reported by Denmark, Finland and UK-Northern Ireland were for UTI prophylaxis. These countries also had a high percentage of UTI prophylaxis in the HALT-2 PPS. In Finland, half of the prescriptions for UTI prophylaxis were methenamine (J01XX05), which is often considered as being an antiseptic rather than an antimicrobial agent, due to its chemistry and absence of a notable association with AMR [21]. For example, almost all use of 'other antibacterials (J01X) in Norway was methenamine prescribed for uroprophylaxis.

The percentage of UTI prophylaxis in Norway decreased from more than 40% in the HALT-2 PPS to 13.1% in this HALT-3 PPS [2]. Notably, the national representativeness of Norway's LTCF sample was 'optimal' in the HALT-3 PPS due to the conversion of PPS data, whereas it had been 'poor' in 2013. Conceivably, though, such a decrease might have been due to the introduction of mandatory LTCF participation in periodical PPSs in LTCFs in Norway, which would have incentivised improved antimicrobial stewardship [9].

In specialised facilities, the prevalence of antimicrobial use was remarkably similar to that in the three aggregated main types of LTCF, albeit slightly higher in rehabilitation centres and palliative care centres, and slightly lower in LTCFs for mentally disabled persons, psychiatric facilities and 'other LTCFs'. Moreover, just as in the three main types of LTCF, the most frequently prescribed antimicrobials for treatment in specialised facilities were penicillins (J01C).

As with the multivariable model for HAIs, the model for antimicrobial use only explained a fifth of the variation of the prevalence of antimicrobial use, after adjusting for the same care load indicators and risk factors between and within countries. It also identified that several of the included indicators and risk factors were independently and positively associated with a higher prevalence of antimicrobial use. Classifying the LTCFs by their risk score was useful, as it was associated with prevalence of antimicrobial use, explaining part of the variability between countries and LTCFs, and it also allows calculation of standardised antimicrobial use ratios for each LTCF. Such a standardised ratio may be used in future studies to focus on antimicrobial stewardship activities and benchmarking between LTCFs.

In HALT-3, validation teams only assessed whether or not an antimicrobial agent was used by eligible residents in that LTCF. The HALT-2 validation survey had collected much more granular data on antimicrobial use, and the calculated sensitivity and specificity had been notably high. Therefore, this was limited to just one question in the HALT-3 validation study protocol, to improve its feasibility. As expected, the specificity of the antimicrobial use data in the validation sample was very high, with few false positives. Its sensitivity was also relatively high (89.2%). Some antimicrobial agents had not been located by the primary survey team in the residents' notes, whereas other non-typical antimicrobial agents such as methenamine (J01XX05) had been omitted in error.

4.6 Structure and process indicators

As in the previous HALT surveys, the HALT-3 protocol included a questionnaire to collect information from each participating LTCF regarding structure and process indicators of IPC and antimicrobial stewardship.

Even though the questions were standardised, interpretation of the responses was complicated by national differences in the organisation of healthcare provision. For example, LTCFs that have prescriptions made by external physicians will have a different implementation of antimicrobial stewardship policies than LTCFs which employ in-house GPs. Additionally, the responses from participating LTCFs might not represent the national situation. This could be due to non-representativeness of the national LTCF sample, with, for example, LTCFs volunteering to participate if they assess themselves to have good IPC practices. Otherwise, this could be due to incorrect responses. For example, in Norway, which had 'optimal' representativeness, the national team noted that 'all LTCFs in Norway have surveillance for resistant organisms', while 15.5% LTCFs had stated that they had this. Similarly, it was recommended that LTCFs in Norway 'should follow national guidelines for antibiotic use for all types of infections', but only 22.4% LTCFs in Norway stated that they had such guidelines. Still, the data suggest improvements in the provision of IPC in LTCFs in Europe since 2010/2013.

In the HALT-2 PPS, antimicrobial stewardship was identified as a clear area requiring improvement, with almost half (46.0%) of the participating LTCFs reporting that they had none of the 10 explored antimicrobial stewardship elements in place [2]. In the HALT-3 PPS, these indicators had improved, with less than a third (28.5%) of the LTCFs having none of these elements, a decrease of 17.5%. Availability of each included antimicrobial stewardship element had improved between these two surveys by 14.7% on average, except for 'permission for prescribing restricted antimicrobials' which decreased by 4.4%. The largest improvements were observed for 'a system to remind healthcare workers of the importance of microbiological samples to inform the best antimicrobial choice' (+22.5%), 'written guidelines for appropriate antimicrobial use' (+19.4%) and 'the presence of an antimicrobial committee within the LTCF' (+18.4%).

The percentage of LTCFs with all three IPC structures in place (i.e. in-house and external IPC expertise, and an IPC committee) had increased between the HALT (21%) and HALT-2 (31%) PPSs, but remained unchanged in the HALT-3 PPS [1, 2]. Access to external IPC 'help and advice' increased from 79.1% to 84.6%. During onsite assessment visits, some countries (e.g. Austria and Finland) indicated that more LTCFs had developed close collaborations with nearby hospitals that provided IPC expertise and advice. Others had such collaborations with certified companies, e.g. the Netherlands. This may partly explain the slight decrease in the percentage of LTCFs with an IPC committee between the HALT-2 and HALT-3 PPSs, from 42.6% to 39.1%, although the differences between the HALT-2 and HALT-3 PPS samples in terms of participating countries/administrations and LTCFs may certainly also explain such a small difference. Conversely, the availability of a person with training in IPC at the LTCF increased from 66.5% in the HALT-2 PPS to 71.0% in the HALT-3 PPS.

More LTCFs had a written protocol for the management of MRSA and/or other MDROs in the HALT-3 PPS (82.2%) than the HALT-2 (76.9%) or HALT (72.6%) PPSs. Also, compared to HALT-2, in the current survey (2016–2017) more LTCFs had surveillance programmes for HAIs (from 29.7% to 35.5%), antimicrobial consumption (from 16.1% to 31.0%) or antimicrobial-resistant microorganisms (38.5% to 41.5%) [2]. None of these PPSs in LTCFs collected information on the provision of MDRO surveillance by other institutions. For example, in UK-Scotland, MDRO surveillance in LTCFs is performed by IPC teams from hospitals.

In 2012, the World Health Organization (WHO) adapted its 2009 guidelines for hand hygiene in healthcare for non-acute settings, including LTCFs. It recommended four 'moments' for hand hygiene when care delivery takes place in residential care, and five 'moments' in settings where healthcare workers would touch relevant patient surroundings, such as medical equipment [22]. Overall, fewer LTCFs reported having provided staff with hand hygiene training in the previous year in the HALT-3 PPS (66.0%) than in the HALT-2 PPS (73.4%). Although five countries/administrations reported a higher percentage in the HALT-3 PPS than in the HALT-2 PPS, 11 countries/administrations reported lower percentages of LTCFs having provided staff with training on hand hygiene, an essential measure to prevent HAIs and transmission of microorganisms [2]. The HALT-3 protocol also requested information from each LTCF on the number of observations of hand hygiene opportunities during the previous year. However, many OCPs reported that this question was not well understood or accurately completed by LTCFs. The data for HALT-3 supported this hypothesis. Therefore, this indicator was not retained for analysis. The draft protocol had also contained an indicator on hand hygiene compliance, but this was not included in the final HALT-3 protocol as the OCPs indicated that this would be even less feasible to collect.

The 2012 WHO guidelines recommend that alcohol-based hand rub is used as the preferred means of routine hand hygiene for all healthcare settings [22]. In the HALT-3 PPS, a higher percentage of LTCFs reported disinfection with an alcohol-based hand rub solution as their main hand hygiene practice compared to the HALT-2 PPS (70.3% and 56.2%, respectively). The median use of alcohol-based hand rub remained unchanged at 4.3 litres per 1 000 resident-days in 2016–2017 [2]. Hand washing with soap and water was the most common hand hygiene technique in the participating LTCFs in Cyprus, Greece, Hungary, Lithuania, the Netherlands, Slovakia and the three participating UK devolved administrations.

4.7 Future steps and recommendations

In the 21st century, the EU will continue to have an increasing proportion of older people. The HALT-3 survey, the largest PPS in European LTCFs to date, estimated a prevalence of HAIs and antimicrobial use that was essentially unchanged since previous surveys (HALT in 2010 and HALT-2 in 2013), but it recorded improvements in LTCF-level structure and process indicators of IPC and antimicrobial stewardship.

The following areas of priority for LTCFs were identified for those working at the national and EU levels:

- Recommend to LTCFs that they participate in periodic PPSs of HAIs and antimicrobial use (Member State level);
- Enhance the level of IPC training among healthcare workers in LTCFs (Member State level);
- Reinforce access to external IPC support and expertise for LTCFs (Member State level);
- Encourage hand disinfection with alcohol-based hand rub as the main hand hygiene method, and increase awareness of the importance of hand hygiene in the prevention and control of HAIs and antimicrobial-resistant microorganisms (EU and Member State levels);
- Develop guidance for the detection and control of multidrug-resistant organisms in LTCFs and have guidelines available at national and LTCF levels (Member State level);
- Tailor basic antimicrobial stewardship programmes to improve antimicrobial prescribing in LTCFs (Member State level):
  - to rationalise the use of antimicrobials for prophylaxis;
  - to promote appropriate microbiological sampling in LTCFs;
  - to improve access to microbiological results for LTCF staff in charge of the residents' nursing care.
- Ensure appropriate use of antimicrobial agents for UTIs:
  - by promoting alternatives to the use of antimicrobials for the prevention of UTIs in LTCFs (EU and Member State levels);
  - by developing guidance for UTI diagnosis in the elderly residents, that distinguishes asymptomatic bacteriuria from symptomatic UTIs (EU and Member State levels);
  - by putting down guidelines for the treatment and prevention of UTIs at national and LTCF levels (EU and Member State levels);
  - by implementing the surveillance of UTIs and antimicrobial use for UTIs, at LTCF level (Member State level).
- Continue to study the association between the structure and process indicators of IPC and antimicrobial stewardship in European LTCFs, to support the production of evidence-based LTCF-specific guidelines (EU and Member State levels).

The HALT-3 PPS also made the following recommendations for PPSs in LTCFs, in the future:

- Continue to monitor HAIs and antimicrobial use using a standardised methodology across Europe;
- Continue to provide training to LTCF staff to harmonise the interpretation of case definitions;
- Explore additional measures to promote the participation of LTCFs in these PPSs and also their associated validation studies;
- Promote, in collaboration with national authorities, the importance of having a robust national/regional registry of LTCFs and LTCF beds, to enable the calculation of burden estimates of HAIs and antimicrobial use in LTCFs;
- Continue to ensure compatibility with previous PPSs in adaptions to the HALT protocol, while removing any indicator(s) deemed to have a too high cost/benefit ratio. For example, the utility of collecting data on HAIs associated with stays in other healthcare facilities and the option to report HAIs as 'imported infections' should be critically evaluated.
- ECDC should consider producing a data entry software for PPSs in LTCFs incorporating feedback from users during the HALT-3 PPS.

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